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BSc

Business Analytics

How economic indicators correlate with the active number of military personnel in NATO countries

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Abstract

This thesis examines how key economic indicators correlate with the number of active military personnel across NATO countries. As many NATO member states are faced with difficulties in military recruitment and retention, understanding the socio-economic drivers behind these issues is critical for defence planning. The study focuses on four indicators: unemployment rate, GDP, defense spending, and educational attainment to assess their relationships with military labor supply.

A panel dataset covering multiple years across NATO countries was compiled using data from The Military Balance and the World Bank. The analysis includes a correlation study and a fixed-effects regression model to control for country-specific heterogeneity.

The results show ...

The thesis contributes to a better understanding of military labor dynamics and highlights the need for further cross-country, multi-variable research in this field.

Introduction

Requitment and retention of military personnel has is becoming an increasingly important issue for many NATO countries due to demographic changes, socioeconomic conditions and geopolitical tensions (NATO Research and Technology Organization 2007; *NATO 2022 - Strategic concept* 2025). Understanding the factors that influence military labor supply is crucial for providing advice to NATO policy makers in order to improve defence planning (NATO Research and Technology Organization 2007). This thesis investigates the relationships of unemployment rate, GDP, defense spending and educational attainment with the number of active military personnel in NATO countries. It aims to provide empirical results on how broader economic conditions may affect military labor supply and thus support defense policy formulation.

Previous studies have shown, that higher unemployment rates are often linked to increased enlistment, for example in Sweden and the United States, while findings from the Czech Republic have suggested more complex relationships (Bäckström 2019; Asch et al. 2010; Holcner et al. 2021). GDP and defense spending have been studied as signals of a country’s civilian and military economy, which influences the choice of military employment, though results remain mixed (Warner and Asch 1995; Holcner et al. 2021). Furthermore, educational attainment is seen as both a requirement for modern armed forces seeking highly skilled personnel and a challenge for personnel retention (CNA’s Resources and Force Readiness division 2025; Hof, Zuidema, and Pennings 2023). While existing research often focuses on individual countries or isolated variables, this thesis takes a broader approach by analyzing data across multiple NATO countries and over several years, aiming to fill a notable gap in the literature and find generalizable results.

Literature Review

This literature review explores the research on the influence of socioeconomic factors on military labor supply. Recruitment and retention in the military has been studied using a wide range of different factors. According to a report by the NATO Research and Technology Organization (2007), the recruitment and retention issues in NATO countries are caused by factors such as low unemployment rates, military operational and personnel tempo, higher civilian salaries and the shrinking pool of 18-24 year old individuals - among other challenges. External competition for labor supply pool, recruit quality and compensation have also been reported as some of the reasons individuals have expressed for not choosing a career in the military (NATO Research and Technology Organization 2007). This review aims to investigate how factors such as GDP, unemployment, education and defence spending impact the attractiveness of the military as an employer. It focuses on quantitative studies in NATO countries in order to identify current knowledge of military recruitment and retention, while also determining gaps in the literature that this thesis aims to address. First the effect of unemployment rates will be discussed, then GDP and defence spending and finally educational attainment.

The assertion that low unemployment rates cause recruitment and retention issues is supported by several authors such as Bäckström (2019) who found a positive and statistically significant correlation between unemployment and military application rates in Sweden and Asch et al. (2010), who similarly found unemployment rate to be positively and significantly related to high-quality enlistment contracts in the United States. These findings align with research by Balcaen and Du Bois (2025) who found a one percent point increase in unemployment rate to result in a 0.0137 percentage point increase in military application rates. However, some evidence also suggests the opposite, for example Holcner et al. (2021) found an inverse relationship between unemployment and military recruitment in the Czech Armed Forces.

Warner and Asch (1995) describe the decision to enlist and to remain in the

military as a choice between employment in the military or the civilian sector. The study mentions that a perfectly rational individual join the military sector if the pay differential between the sectors exceeds the preference for civilian life. Warner and Asch (1995) also note that the USA and its allies spend a significant amount of their defence budgets on military personnel. This means that GDP and defence spending along with their dynamics could reflect employment opportunities in the civilian and military sector and in turn be correlated with choices to enlist and stay in the military. Although Bäckström (2019) researched mostly unemployment rates, he highlights the fact that a stronger civilian economy increases the difficulty of recruiting new military labor force. On the other hand Holcner et al. (2021) found that the annual increase in GDP, indicating a growing economy, had a positive impact on the recruitment to the Czech Armed Forces. The annual increase in defence expenditure was also found to be correlated with a higher number of military recruits (Holcner et al. 2021).

The U.S Department of Defence has a benchmark of at least 90% of new military recruits having secondary education or higher (CNA's Resources and Force Readiness division 2025). This emphasizes the fact that the military is looking for educated recruits. Asoni and Sanandaji (2013) also argue that the transition to a smaller and technologically advanced military has made the recruitment process more selective and less likely for an individual to be allowed in the military without a high-school degree. Elster and Flyer (1982) found that the the four-year retention rates were higher amongst U.S military recruits with a high-school degree, compared to those with lower educational attainment, however this study was conducted with data from the 1970s, which may not reflect the current socioeconomic or military environment. In contrast, a more recent study by Hof, Zuidema, and Pennings (2023) found that in the Dutch Armed Forces, recruits training to become officers, who have a higher level of secondary education prior to enlistment, show higher intentions to quit basic training, than those training to become noncommissioned officers, who have a lower level of secondary education. The study hypothesizes that recruits with a better educational background could believe that they have better opportunities in the civilian labor market.

This literature review has shown that socioeconomic factors such as unemployment rates, GDP, defence spending and educational attainment can have a notable impact on military recruitment and retention. Unemployment rates are often found to be positively correlated with enlistment, however some evidence suggests more complex or even the opposite relationship. It is often assumed that a stronger civilian economy increases the difficulty of obtaining and maintaining military personnel and that a stonger military economy should attract recruits as better pay is offered, although these aspects have not been extensively studied. The literature also suggests that the military is actively recruiting individuals with a higher educational attainment, but the research reflects mixed results on the impact of educational attainment on personnel retention. The varied results and the fact that most studies focus on a single country highlights the need for further research across multiple NATO countries.

Case Background

NATO (North Atlantic Treaty Organization) is a security alliance established in 1949 (*About NATO* 2025). As of 2025, NATO consists of 32 member countries from North America and Europe (*Member countries* 2025). Its primary mission is to ensure collective freedom and security of its members through political and military means (*About NATO* 2025). Among others, NATO currently faces threats such as Russia's invasion of Ukraine, China's growing ambitions and conflicts in the Middle East and Africa highlighting the need to further strengthen its deterrence and defence capabilities (*NATO 2022 - Strategic concept* 2025).

It has become increasingly difficult in many NATO countries to recruit new and retain existing qualified military personnel. This can be attributed to a variety of factors, including socioeconomic conditions. (NATO Research and Technology Organization 2007) In light of this, this thesis explores how a selection of economic indicators influence the number of active military personnel in NATO countries.

The indicators unemployment rate, GDP and defence spending dynamics and educational attainment were selected for this thesis. The data for unemployment, GDP and educational attainment were obtained from the *World Bank Open Data* (2025) and the data for defence spending and active military personnel were sourced from *The Military Balance* (2025). The data was collected for the years (timeframe!!!!!!!) across all NATO countries (and Russia and China?????). Data was then harmonized to create a dataset suitable for analysis.

Methodology

5.1 Data Preparation

Table 5.1: Variable Descriptions

Variable	Description	Source	Unit	Transformation
Active armed forces per capita	Number of active military personnel per capita	Military Balance, World Bank	per capita	log()
Unemployment rate	National unemployment rate	World Bank	%	none
Secondary education rate	Proportion of population with secondary education	World Bank	%	none
GDP per capita	Gross Domestic Product per capita	World Bank	2015 USD	log()
Defence spending per capita	A country's defence expenditure divided by population	Military Balance	2015 USD	log()
Defence spending % of GDP	Defence expenditure as a share of GDP	Military Balance	%	none
GDP per capita change	Annual percentage change in GDP per capita	World Bank (own calculation)	%	none
Defence spending change	Annual percentage change in defence spending per capita	Military Balance (own calculation)	%	none
Defence spending % GDP change	Annual percentage change in defence spending as % of GDP	Military Balance (own calculation)	%	none

The data preparation process involved several steps to create a clean and structured dataset that could be used for analysis. The study combines military and socioeconomic data for NATO countries across multiple years. Data was collected from various sources, transformed into a consistent format and merged into a single dataset.

First, the military personnel and defence spending data were acquired from different issues of *The Military Balance* (2025) as each issue contained data for a specific

year. Columns with relevant information were selected from each table and renamed to ensure consistency across the dataset. A list of countries of interest was created to filter only NATO member countries from the tables. Data types were then adjusted so that numerical values were presented in a consistent format. The tables from different years were then merged into a single long-format table, where each row represented data for a specific country in a specific year as this format is suitable for panel data analysis.

Next, the unemployment rate, GDP and educational attainment data were collected from *World Bank Open Data* (2025). These datasets included data across multiple years, so the columns with relevant years were selected and renamed for consistency. Again a list of countries was used to filter out only NATO countries. The educational attainment data had missing values that were filled using interpolation (or backwards/forwards fill) from the previous and next years. The tables were then also transformed into a long format, so that they could be merged with the military personnel and defence spending data.

Finally, in order to ensure that the data is comparable, the effect of inflation was removed from columns with monetary values by adjusting them to 2015 USD using the Consumer Price Index (CPI) of different years. The CPI data was sourced from Federal Reserve Bank of Minneapolis (2025). The military and economic data tables were then merged into a final dataset and additional columns for year-on-year changes for GDP per capita, defence spending per capita and defence budget as a percentage of GDP were calculated using the existing data.

5.2 Analysis

The analysis consisted of a preliminary correlation analysis and a regression analysis. ...

The correlation analysis was performed on a subset of the data to identify potential relationships between socioeconomic indicators and the number of active military personnel. The subset of data included values from the year 2023 as it was the latest year with complete data available. A log transformation was applied to variables population,

GDP, GDP per capita, defence spending per capita and the dependent variable active military personnel to mitigate the effect of skewness and to more efficiently capture the multiplicative relationships between variables. The Pearson correlation coefficient was calculated along with the p-values to determine the statistical significance of the correlation values.

The regression analysis used a fixed-effects regression model to control for heterogeneity across countries (Bäckström 2019).

Results

6.1 Correlation Analysis

The correlation analysis revealed several significant and insignificant relationships between the socioeconomic indicators and the number of active military personnel.

First, a strong positive correlation was found between the log transformed active military personnel and the log transformed population ($0.96, p < 0.001$). Population was added as a control variable as it was expected that countries with larger populations also have potential for a larger military. A strong positive correlation was also found for the log transformed GDP ($0.85, p < 0.001$), which also makes sense as wealthier countries should be able to afford larger militaries.

A significant negative correlation was discovered for the annual change in defence spending per capita ($-0.36, p = 0.037$). This suggested that countries where defence spending per capita increased from the previous year tended to have a smaller active military force. A negative correlation, although not significant, was also found with unemployment rate ($-0.25, p = 0.17$) and the annual change in defence spending as a percentage of GDP ($-0.29, p = 0.11$).

6.2 Regression Analysis

6.2.1 Sensitivity Analysis

A sensitivity analysis was conducted to determine whether to include interpolated and filled educational attainment data in the regression model. Three regression models were created: Model A with complete data, including observations with interpolated educational attainment values, Model B that excluded rows with interpolated values and Model C with complete data and an additional dummy variable indicating whether the

education data was interpolated or not.

Table 6.1: Sensitivity analysis models

Term	Model A (full)	Model B (excl. filled)	Model C (full + dummy)
<i>Coefficient estimates</i>			
Secondary education attainment rate	$-0.0075, p = 0.0001$	$-0.0054, p = 0.0078$	$-0.0076, p = 0.0001$
Interpolation dummy	-	-	$-0.0536, p = 0.0371$
<i>Model statistics</i>			
Number of observations	285	262	285
R^2 (within)	0.2066	0.2194	0.2206
F-statistic (robust)	$F(8, 245) = 7.97, p < 0.001$	$F(8, 222) = 7.80, p < 0.001$	$F(9, 244) = 7.68, p < 0.001$

The secondary educational attainment rate coefficients stayed consistently negative and statistically significant across models. Additionally, other coefficients also remained with similar magnitudes and significances. This means that using interpolated values does not drastically distort the relationship with the target variable. However the dummy variable for interpolated values in Model C is significant, suggesting systematic differences in observations, where the education rate was interpolated or filled in. The negative coefficient indicates that interpolated observations tends to have slightly lower values of dependent variable, holding everything else constant.

Based on these results, Model B was chosen as the preferred regression model. Imputed data could create noise or subtle bias, which was supported by the fact that the interpolation dummy was found to be statistically significant. Additionally, Model B had a marginally larger within country R^2 , meaning it explained the variation within countries slightly better than Model A. A limitation of choosing Model B is that it has less observations, which may weaken the statistical power, however the loss of statistical power seemed modest.

Statement of work

This thesis contains only work done by the author. No sections are based predominantly on group work. I, Joosep Roots, take full responsibility for the content of this thesis.

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