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Exploiting NATOs membership for national security, a free riding dilemma

An exploration on free riding behavior between NATO member states. How some countries benefit from military safety on behalf of others.

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Abstract

Multilateral alliances bring together multiple parties in the name of a particular objective or mission. The North America Treaty Organization (NATO) applies to this definition, bringing together – as of 2022 – thirty one countries arraying from the Americas to central Europe in order to ensure common peace and security. Be it times of war or times of piece, economic theory advocates for the free rider dilemma surfacing as soon as multiple parties join forces. This paper will explore the presence of free riding behavior of countries belonging to the NATO alliance. On the basis of military expenditure over national GDP, this research observes on whether certain members benefit of the military security provided by their NATO status on behalf of other member countries. Results showcase that neighborhood security and regional peace are the main drivers of spending levels decisions above any other variable. More, data sheds light on the effectiveness on NATO's 2% contribution target set in 2006; which aims to stabilize all members spending amounts in order to evade free riding behavior.

Introduction

In a world where collective security and mutual defense create the foundation to international alliances as we know them, since 1949 the North Atlantic Treaty Organization (NATO) boasted an imperative level of military power, combining capabilities of many countries ability of addressing a diverse spectrum of challenges. Across all missions, NATO has proven to be true to its core mission: safekeeping peace and fostering stability in the North Atlantic hemisphere. Once more, the world is in a challenging position, where the North Atlantic Treaty Organization may have to take tipping point decisions.

In the recent past NATO has faced difficulties which required different skill sets, expanding from on ground defense to military policy cohesion. These went from effectively overpowering the Soviet Union in 1991 to more modern types of threats, such as cybersecurity attacks and climate crisis adaptation. However, the alliance was born under the need of military action to ensure peaceful times, which the North Atlantic hemisphere reached after achieving military stability following the Cold War. Thus, as general peace governed starting the 90s, the alliances' relevance and purpose came into question: NATO was never equipped to face non-military centered challenges.

Questioning the alliances pertinence also arose from large political actors such as Macron, whom in 2019 had described NATO as a "brain dead" organization for it's lack of coordination and activity (The Economist, 2019). Could this have been dissatisfaction toward internal frictions or the result of the security and defense changes? The previous president of the United States, Donald Trump, had also openly criticized the organization in 2019 (Moran, 2019), hindering the alliance's image and relevance.

Brzezinski (2009) addressed these worries in his paper, advocating for the groundbreaking transformations brought from the alliance; which, being still relevant even after 60 years from NATO's first assembly in 1949, should derail from suggestions of disbanding the alliance on the sole argument of the original *military adversary* no longer existing. Though, "An Agenda for NATO: Toward a Global Security Web" (Brzezinski, Z., 2009) suggests NATO should have undergone significant transformation to adapt to the modern threats in order to reach its own potential. The paper lingers on the geopolitical and policy recommendations for NATO to engage Russia, on reaching out to China and become a stronger hub for member countries.

Years before Brzezinski, the paper "NATO's Persistence after the Cold War" from McCalla (1996) also advocates for NATOs relevance and specifies the current need of transforming itself in order to create appropriate responses to modern threats rather than simply breaking the alliance. Although agreeing on this

need, McCalla takes more care in analyzing the alliances' internal organizational improvements which would translate on the multinational nature of the organization in its modern needs. Thus, this paper brings forward a neo-realist and an international institutional alliance theory, in which the author debates – among others – two items. Firstly, the need of cutting on military spending post conflict, following the decrease of the military threat that had justified the increased level of defense expenditure previously. Secondly, re-routing all member countries towards a cheaper and efficient international cooperation.

While these two papers underline the importance of NATO in the geopolitical and defense world, investigating the ways in which the organization can undergo significant transformation to adapt to (1) the changing environment, (2) the organizational and (3) the political commentaries still leave unsolved an issue valid across any argumentation. Namely, this persistent challenge which concerns the burden sharing within the member states, with some shouldering a larger portion of the alliance's expenditure burdens compared to others.

This looming free riding difficulty puts to question NATOs overall ability to keep unity, adapt and evolve. Can member states continue on cooperating even if some are enjoying a piece of the collective pie whilst others are carrying a disproportionate burden? Free riding behavior could increase friction among diplomatic envoys to the alliance and may hinder sentiments of collaboration on the military and political front as NATO remains bounded to consensus as a decision making rule.

Thus, diving deep into uncovering whether or not we observe free riding behavior among countries and unmasking the complex characteristics of such behavior can provide insights to NATO members and their respective geopolitical conversations. Whose action, as history shows, can have large societal impact to the North Atlantic and global sphere.

Policymakers, Defense Ministers and scholars alike have been interested in understanding the root cause of such power disparities regarding military budgets. In the early 2000s Noetzel and Schreer (2009) describe NATO as an *alliance à la carte*, "just on paper" as they discuss the internal division between member states, asserting that confronting the free rider dilemma is essential to bring back credibility and collective efficiency, especially as stakes grow higher. Were Donald Trump's criticism of NATO allies free riding on the United States valid? (Moran, 2019). Conflict withing the alliance may result in larger scale disastrous consequences on global safety and security.

With the most recent Russian-instigated war and Ukrainians willingness to join the alliance, the debate of freeriding is ever more relevant. Non belonging to the organization, NATO is not entitled to take action,

however, the scale of the conflict is putting at risk many of the core values not only of the organization but also of humanitarian principles. This requires member states to reconvene on military expenditure levels which as McCalla mentions in his paper, should have decreased. Hence, discussion on the free riding arise once more regarding historical behavior of members and the future imbalance resulting from the potential entry of economically damaged country.

Theoretical Background

The North Atlantic Treaty Organization, born in 1949, had the primary mission of securing global military stability over the member states and surroundings. Since its founding date, the alliance has expanded to include many other countries, to reach 31 members as of 2022. As the expansion occurred, power roles between countries and economical military capabilities became an issue as a reflection the free riding dilemma.

In the case of NATO, the free riding behavior is experienced as a handful of members benefitting of the alliance more than others, whilst inadequately contributing compared to others. In the context of this organization, the burden sharing does not fall much under the organizational aspect, as the consensus rule and the equal representation of members doesn't allow for much shirking. Rather, it is observable in the uneven proportion of defense expenditures which allows countries to rely on the contributions of fellow members. Moreover, alliances have been thought to be pure public goods, where the benefits of spending are both non-rival and non-excludable in consumption; hence, making free riding intrinsic of the organizational model (Olson, M., Zeckhauser, R., 1966). Sandler and Hartley (2001) build up this conviction on the base of the Olson-Zeckhauser model, lending additional support on the prediction that larger countries carry a disproportionate bigger share of expenditures in alliances. The theorization of alliances nature, and it's later confirmation, set the base to many studies in this field.

In a simple model, Gonzalez and Mehay (1991) test the relationship between NATO's member states expenditure levels in dollars and the population size and wealth shares. This was done on a panel data between 1974 and 1984 - 15 years – on the members at the time: Belgium, Canada, Denmark, France, Germany, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Türkiye, United Kingdom (UK) and United States (U.S.). The study showed how private benefit dominates over the level of nations

output, which was found to be correlated to national defense budgets. Thus, proving the existence of free riding behavior.

However, two realizations exposed the inconclusiveness of the paper as a whole. Firstly the authors observed that counties differ too much and have unique characteristics: Luxembourg for instance has no exposed borders to attack, making it prone to cut on border defense budgets. Secondly, the realization that – no matter how strong – the NATO alliance may not be the sole commitment to military action. As a matter of fact, adding the U.S. to their model created an upward bias in the expenditure levels because of the nation's diverse external commitments in comparison to others. Thus, Gonzales and Mehay recognized their limitations and the requirement of larger comparative research in order to eliminate omitted variable biases.

As just mentioned, observing non-NATO commitments is essential for the dissecting free riding behavior among countries. Though another valid factor integrable to the model would be a comparison between member countries to the alliance and the main opposing belligerent party. A later study conducted over the periods of 1950 to 1986 attempted analyzing the financial burden sharing of members by including variables meant to control for the geopolitical counterparties. Oneal and Diehl (1994) consider making a comparison between member's expenditure levels and those of the United States and the Soviet Union respectfully.

The result of this research validate the 'public good' nature of the alliance described by the earlier peers Sandler & Hartley and Olson & Zeckhauser. This sheds light on how free riding behavior may not be dampened from the expenditure decisions taken from counterparties, such as the Soviet Union which they included in the model. Moreover, another interesting find of this study is the decreasing impact of country size on military expenditure. Although remaining statistically significant, the coefficient saw a decrease 0.16 in absolute value. Suggesting that the nature of an alliance intrinsically creates the opportunity of free riding and only the economic strength of the nation may have a say in the budget given to defense expenditures.

Although these papers seem to universally agree with each other, there is a common tendency is to create a more accurate methodology: they all take on either specific timeframes and/or control variables which are now outdated. Ultimately undermining the relevance of these papers to this day. Moreover, as time passes and more data is available, more countries become members and there is more space to create an updated framework.

One of the most recent studies attempted to cover these drawbacks, whilst relying on the validity of the homogeneous literature of the previous paragraphs, is from Plümper and Neumayer (2015). They focus on

the small countries of the alliance as a sample: Belgium, Canada, Denmark, Great Britain, Greece, Italy, Netherlands, Norway, Portugal, Turkey and West Germany. They collected the expenditure per GDP over the period of 1956 – 1988 and tried to mitigate OVB by including an identification of countries who have geopolitical frictions and/or exposed borders, as both could lead to either having larger budgets or bigger incentive to free-ride.

The researchers revisit Oneal and Diehl's paper (1994) by keeping the spending levels of the U.S and Soviet Union as independent variables (IV). Though, Plümper and Neumayer (2015) calculated response functions on the IVs growth over time, creating a "free riding threshold" between the U.S. spending and the Soviet Union's Spending. To which, if countries were out of such threshold, it meant free riding behavior. It resulted that all countries observed fell out of the threshold and, hence, confirmed as free riders.

Although adopting a different methodology, all literature point to the existence of unequal financial burden sharing across NATO's member states. Moreover, the limitations in the older research papers have not been completely addressed and overcame from Plümper and Neumayer (2015): the timeframe observed remains limited and IVs included still leave space for biases.

The authors themselves find limitations in their model. While they observed small countries free ride, it was not possible to quantify the between-sample differences. In fact, there was no distinction on whether the smaller half of identified countries free rode more than the larger half of the group. Moreover, the paper did not take into consideration if the countries in question were partaking in any wars themselves: this would bias the analysis towards free riding behavior because superpowers such as the U.S. and the Soviet Union, which were taken as base, have an active belligerent record.

This research paper takes momentum from the possibility of updating and improving the research made on this topic. This will be done by widening the timeframe, updating the member's list and incorporating many more independent variables to try and contain OVB.

Most importantly, this research analysis will consider an important milestone in NATO's attempt to bring equality to the alliance: a two percent expenditure target. In 2006 NATO's Defense Ministers unanimously agreed on a "2% defense investment guideline" (NATO, n.d.). This percentage is calculated on members' national GDP and it aims at both unify the contributions to the alliance and increase the politico-credibility of the organization against speculations. The crucial element on the 2% target is that it is not a number that has to be reached on a must. Rather it's the indicatory value requested, which means that countries have

some wiggle room to be slightly below or above. It goes without saying that countries can go over the 2% of the amount they wish to.

The argumentation that a 2% contribution target may actually lay the foundation for free riding is plausible. However, basing the percentage on national GDP makes it so that the North Atlantic Treaty Organization requests contributions in an equitable way.

Furthermore, it has been calculated that larger countries - such as the United States - not only contribute more, but also make use of an equally larger defense budget compared to all the non-US allies (NATO, n.d). This research alone could sway from debates on unequal burden sharing among member states. Additionally, this latter research would lead us to believe that implementing the 2% target might have solved the free riding behavior associated with alliances altogether; however, as accusations still remain the relevance of broadening burden sharing researches with variables increases.

Once more, we observe the need to update the previous researches made in this field, with the aim of enlarging, updating and consolidating data but most importantly tailoring the study to make it relevant to current state of affairs.

Methodology

This study's objective is to observe the defense expenditure history of NATO's member countries in order to (1) observe whom appears to be free riding on other members for the sake of obtaining an otherwise unreachable levels of military security and (2) to observe which country characteristics are more likely to describe a free riding member.

Assessing whether being a NATO member entails signing up for security benefits, unobtainable without the alliance, can be done primarily by retrieving and comparing the levels of military spending as a percentage of national GDP, a continuous variable. The countries this study gathers time series data are: Albania, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Türkiye, the United Kingdom (UK) and the United States of America (US).

The majority of the data has been collected from the NATO Annual Report's, however, the reports did not cover the years between 1960 to 2022 homogeneously but as follows: the year groups (1990 – 1994); (1995 – 1999); (2000 – 2004); (2005 – 2008) were reported as averaged data of the mentioned timeframes. Starting from 2009 up to 2022, all data was reported yearly (please see appendix). In order to have data which reached earlier dates, this study used the World Bank (WB) database in order to go as back as 1960.

While the under-investing amounts hinting to free riding behavior can be observed by the collected data. In order to complete the second part of the research paper, the variable of interest of this paper, namely, expenditure level as percent of GDP, had been denominated as *ex_pGDP*.

Moreover, in order to observe which characteristics are most likely inducing or describing a free riding behavior, other variables apart from the above-mentioned had to be individually sought. Incorporating such independent variables in the regression is relevant to understand the behavior of military spending and make sure to avoid omitted variable biases (OVB).

Data on whether a country experienced alliances or treaties aside of that of NATO was collected with a binary value of yes/no. Theoretically, it is plausible that spending amounts are affected by other commitments taken outside of the North Atlantic Treaty Organization, hence, the relevance of this variable. As a matter of fact, most member countries are part of the European Union (EU) partnership, which also enforces common policies and spending exigencies. For such countries, this sets an extra layer of compliances for when governments have to budget defense expenditures and targets. Other non-EU major countries are also subject to creating additional alliances aside of NATO. The United States of America and Canada, for example, have a broader alliance horizon which extends to oriental countries. As for EU countries, this also entails that governments need to consider more factors when thinking about the budgeting of military expenditures. In the model, this variable has been denoted as *Defense_Commitment*.

When it comes to military spending, both regional security and economic stability play a large role in discerning if funds will be allocated in this sector, given or not the need to do so. The expectation is that, as a country experiences political distress, governments expand the budget for national defense to readily subdue civil revolts or protests at occurrence. Additionally, budget expansions and contractions can also be influenced by the economic situation a country finds itself in. Thus, this research paper includes information on the deficit level as a percentage of national GDP over the years, for each country. We ultimately expect larger deficits to dampen the amount of military expenses and thus have a negative coefficient in a regression.

Respectively these two variables have been integrated in the framework under the name of *Regional_Security* and *Deficit_pGDP*.

Although previous literature had declared country size being of little importance on free riding, the analysis had not been done by observing countries spending as a portion of national GDP. Thus, country size is included in this paper due to the assumption that national GDP has a causal relationship with population size rather than country size. With this in mind, we can assume to not suffer from reverse causality, thus results must be interpreted whilst taking this into consideration. The variable was taken as square kilometer. Intuitively, as the square kilometers increase, we expect the cost of maintaining regional security to rise, consequentially increasing – ceteris paribus – total defense expenditure. The WB database was also used to obtain the square kilometer values of the countries of interest and their national deficit in percentage of GDP, which were variables not present in the NATO annual reports.

However, both contemporary times and history has shown that one countries conflict problems can easily pour into confining regions. Hence, a variable on neighboring conflicts is added to this framework. We expect that neighboring conflicts also increase local unrest, hence inducing governments to increase military spending to prevent external threats to trickle over the border. For this binary variable, the selection of yes/no was made arbitrarily by observing if the country in question directly confined with another suffering from reginal civil unrest, if not even war. The rule was bent for the most recent war initiated by the Russian party: being a war of incredibly larger scale compared to others observed starting 1960 and with significant global implications, all European countries have been identified as neighboring to Ukraine. In this study, the above variable was denoted as *Neighbouring_Confilct*.

Moreover, governments may distress if there is national unrest and neighboring conflict at the same time. Not only can one's communities disorder be the drop that broke the camel's in the bordering one, but the two can also fuel each other's conflict intensity. Ultimately making governments spend even more money on military defense. To mitigate the potential reverse causality between the two variables. One of the regression models includes an interaction effect between the mentioned variables.

The statistical computations have been made in STATA, data has been converted to long version and transformed from string data to numerical. Three variables are recorded as binary: defense commitments, neighborhood conflict and regional security.

The commands used can be found in the appendix of this paper (see table 8). The unit of measure for each variable and their brief denominations can be found in the table below.

Table 1: Description of variables used in the regression on STATA

Variable Name	Description	Unit of Measure
Country	String variable listing all countries which are present in the study	n/a
compid	Transformation of variable *Country* from string to numeric format, recognizable to STATA	n/a
c_id	Variable assigning numeric values to each country recognized in variable c*ompid*	n/a
year	Variable showcasing the range of years where data is collected. Range [1960; 2022]	365 days/1 year
Defense_Expenditure_pGDP	Dependent variable of the research paper as a string variable. Amount of national expenditure occurred in a particular period in time on security and defense reported as a percentage of national GDP	USD
ex_pGDP	Transformation of variable *Defense_Expenditure_pGDP* from sting to numeric, recognizable to STATA	USD
Deficit_pGDP	String variable. Amount of annual national deficit observed in a particular period in time, reported as a percentage of national GDP	USD
def_pGDP	Transformation of variable *Deficit_pGDP* from string to numeric, recognized by STATA	USD
Defence_Commitments	Binary string variable. Describing whether a country engaged in any other alliance or commitment aside of that of NATO.	Yes/No
d_commit	Transformation of variable *Defence_Commitments* from string to numeric, recognizable to STATA	Yes/No
Country_Size	String Variable. Depicting the size in square km of each country.	Square km
c_size	Transformation of variable *Country_Size* from string to numeric, recognizable to STATA	Square km
Neighborhood_Conflict	Binary string variable depicting if neighboring land of a given country is experiencing conflict	Yes/No
n_conflict	Transformation of variable *Neighbourhood_Conflict* from string to numeric, recognizable to STATA	Yes/No
Regional_Security	Binary string variable depicting weather a country is experiencing military distress	Safe/Unrest
r_security	Transformation of variable *Regional_Security* from string to numeric, recognizable to STATA	Safe/Unrest

Generally speaking, models such as the Pooled OLS, the Fixed Effects model (FEM) and the Random Effects model (REM) are ones which can be applied to a time series analysis. Although they're all OLS (ordinary least squares) models, each has its own ways of incorporating and analyzing variables and may or may not be appropriate for certain studies.

In fact, the Fixed Model is not suitable for this panel data analysis. Even though it allows for unobserved fixed common effects, these effects allow for within-comparison only, while this research paper is also interested in comparison between individuals.

Next, the Pooled OLS methods solely looks at between comparisons but does not consider time variables. However, the REM model is a combination of the two above methods, making it the most suitable for this paper amongst the three options. The Random Effects Model allows for time variant variables, can analyze both between and within differences whist assuming zero covariance between the error term and the independent variables. With the independent variables being the ones mentioned in table 1, above.

Supporting the use of the Random Effects model is it's adaptability to a "generalizes least squares" (GLS). The benefit of using a GLS model over an OLS arises with real world data sets which are more likely to suffer from heteroskedasticity. In fact, that national GDP has a causal relationship with population size rather than country size. samples such as the one utilized in this research, we cannot be sure of the no-covariance assumption, our sample countries might not show homoskedasticity in their residuals: what we would expect against what is actually observed.

The skeleton of the regression formula is the following:

$$yit = \alpha i + \beta t_1 \, Xt1 + \beta t_2 \, Xt2 + \beta t_i \, X_{ti} + \varepsilon_{ti}$$

Where:

y_{ti} – dependent variable/variable of interest, defense expenditure as a percentage of national GDP.

X_{ti} – independent variable used to regress the variable of interest.

βti – Coefficient of independent variable

αi – constant variable unique to this regression model

εti – OLS mean-square error term

The regression model is put in place in order to step away from a correlation and move towards quantifying the cause and effect of certain explanatory variables on the research. Once more, the variable country size might have direction problems with our variable of interest however, as mentioned before, is theoretically assumed for this to not be the case. In fact, this paper argues that national GDP has a causal relationship with population size rather than country size. Again, the regression results can only be used if a causal relationship is assumed between the dependent and the independent variables we've.

This research paper meets this requirement because of two distinctive properties. The first stems from the nature of panel data. Collecting a vast amount of data across years allows for a temporal order of events to be put in place allowing for a direction of causality to be observed between the variables. Secondly, although the reviewed sample is not randomly chosen, historic events and connected variables fall under the ideology of natural experiments. This category of experiments dictates that there is exogenous variation in the variable of interest caused by external events, which is applicable to the independent variables of this research paper having been historical events. Thus, the concern of reverse causality is eliminated with the variable of interest. For instances where reverse causality could have been a problem, just like with the variables of neighboring conflict and regional security, an interaction effect is used to mitigate this problem.

By obtaining the numerical data from trustworthy sources, accounting for multiple independent variables controlling for OVB, this paper reaches the internal validity required for a trustworthy analysis. This is also supported by the vast quantity of data collected, obtaining data over 62 years and 31 countries.

However, the external validity suffers for the sole reason that the NATO alliance is – to date – unique. Thus, even if the study and the methodology could be replicated step by step, there might not be similar data on other geographical locations and time period. Nonetheless, this does not lessen the relevance of the results and results hereafter. The insights arising from the results of this paper could still serve as understandings for smaller organizations and alliances but also for most of the military policy makers worldwide, as NATO continues on being a world power.

Empirical Results and Analysis

Reporting military spending as a percent of GDP should nullify size differences among countries which could impact in turn the defense budget. Though, country sizes was included in order to check for potential

anomalies in data results and investigate whether we could have an upward bias from the significantly larger countries.

Thus, two variable statistics are reported both by including the whole sample and by excluding Canada and the United States of America. Figure 1 (see appendix) shows the histogram with the frequency on the y-axis and square kilometer on the x-axis; there is a clear skewness to the left, which justifies checking for the upward bias on the average expenditure levels computed. However, from table 2, we can see that the mean value, second column, does not change drastically between ex_pGDP and ex_pGDP*, proving that no matter having a considerable size difference, all countries reserve a similar percentage of budget to military expenditure, just as expected. This might be due – as mentioned above – by having scaled the expenditure level to GDP level. This diverts from the literature form Oneal and Diehl (1994) and Plümper and Neumayer (2015) whom all advocate for country size positively correlating with expenditure levels. However, in their models, defense expenditures were not scaled to GDP, rather, straightly compared to each other.

Moreover, the mean value of 2. 83% perfectly falls into the 2006 expenditure target NATO instituted for all member states, being of 2%.

Table 2: Summary statistics of the defense expenditure as percentage of GDP and the country size expressed in square kilometers.

Variable	Obs	Mean	Min	Max
ex_pGDP	555	2.83	0.37	9.83
ex_pGDP*	513	2.74	0.37	9.83
c_size	609	774829.50	2586	9147420.00
c_size*	568	172463.26	2586	783562.00

*Note: The values with * have been calculated by leaving out the largest countries in the sample: Canada and the United States of America*

As mentioned before, the goal of the target for defense expenditures was to ensure that all member countries would equitably contribute to the alliances activities of fostering peace. However, the value reported in table 2, collects the mean over 62 years (1960 to 2022) and thus may not be truthful the active economic participation of some countries over the years. Hence, observing the data by marking 2006 as a divisor for the mean computations, can shed more light on free riding dilemma.

Table 3: National average defense expenditure levels as percent of GDP, before 2006 and after 2006

Country	Mean before 2006	Mean after 2006	Difference
Albania	5.70	1.32	-4.38
Belgium	2.39	1.02	-1.37
Bulgaria	1.67	1.56	-0.10
Canada	1.89	1.24	-0.65
Croatia	6.60	1.67	-4.93
Czech Republic	2.00	1.86	-0.14
Denmark	2.05	1.30	-0.75
Estonia	1.32	2.00	0.68
France	3.27	1.93	-1.35
Germany	2.51	1.33	-1.18
Greece	4.16	2.70	-1.46
Hungary	2.38	1.20	-1.18
Italy	2.17	1.33	-0.83
Latvia	1.00	1.47	0.47
Lithuania	1.01	1.41	0.40
Luxembourg	0.82	0.46	-0.36
Montenegro	-	1.61	1.61
Netherlands	2.39	1.33	-1.06
North Macedonia	2.63	1.28	-1.34
Norway	2.69	1.63	-1.07
Poland	2.23	1.97	-0.27
Portugal	1.34	1.42	0.09
Romania	3.02	1.58	-1.44
Slovak Republic	2.05	1.42	-0.63
Slovenia	1.37	1.18	-0.19
Spain	1.85	1.00	-0.85
Türkiye	3.36	1.72	-1.64
United Kingdom	4.16	2.33	-1.83
United States of America	5.23	3.87	-1.35
Average	2.53	1.59	-0.93

The table above, table 3, reports the average expenditure levels as percent of national GDP per country for before and after NATO instituted the 2% target for member countries. This table also includes the delta between the two aggregated periods, which distinguishes the spending before 2006 from the spending undergone afterwards. The negative delta, seen throughout most of the member states, indicates that countries have contracted their military budgets. Estonia, Latvia, Lithuania and Portugal are the only countries which experienced, though very little, and expansion in defense expenditure as a percent of national GDP. Montenegro also has a positive delta, however, this is due to missing data for the years previous to

2006 hence it should not be taken into consideration for this specific analysis as it does not give a valid coefficient.

An increase in expenditure from some members might reflect the necessity to comply with NATO regulations, namely the 2% target. However, the trend observed over most countries is a budget contraction. This trend may indicate that (1) these countries were already dedicating around 2% of their GDP to the NATO alliance and (2) these countries were not willing to spend way beyond this target to start with. The phenomenon of not-overspending could be explained both by the comfort of being able to tap into a larger pool of resources if needed and by not fearing of having a comparatively weaker military power compared to other member states. Thus, table 3 adds to table 2 in showcasing that indeed, after 2006, expenditure levels stabilize across all members, nullifying the possibility of free riding behavior. This is also endorsed from the behavior of certain countries.

Croatia's numbers stand out: from a reported expenditure level of around 6.60% of their GDP on security and defense, the percentage fell as low as 1.67%. Second to Croatia is Albania, with a delta of -4.38 percentage points. Theoretically, if the original expenditure amounts are confirmed as necessary from both countries, the 4.93 and 4.38 percent difference may be explained by free riding behavior.

However, in the 90's both countries experienced civil and neighborhood unrest, which would explain the higher need for security expenditure in the Balkan geographical area in that historical moment. As a matter of fact, the member states which were part of or neighboring the Yugoslavian war, have medium-to-high delta values in comparison to countries who are equally small but at peace in the 90's. The historical context nudges away from the conclusion of a free riding behavior of members: the decrease in spending after 2006 is explained by the termination of the war.

Figure 2 - please see appendix - graphically plots the expenditure levels of each NATO member from 1960 and 2022 to better visualize the trends observed from table 3. The graphs not only visibly confirm the average downward trend in expenditure for all countries up until 2006 but also sketches the sharp increasing instances of the Balkan countries. The graphs also illustrates how, after the 2006 benchmark, most countries stabilize their expenditure levels in a flatter corridor, with the minimum bound being around 2%; drastically diverging from the sharp decreasing trend.

Thus, the contraction of the military budgets observes from table 3 and the plateauing from graph 2 are most likely caused by (1) times of peace and (2) the overarching NATO alliance, able to step in with its military power during unfavorable times which doesn't make members spend more than needed on defense.

However, the United States of America have kept a relatively high level of expenditure as a percent of GDP even after the 2006 floor amount was put into place.

All of the above stresses the importance of the second part of this research paper, that is, pinning out which characteristics affect the decision making process for the target level of national defense budget.

A multivariate regression was made on the panel data. Firstly the defense expenditure as percent of national GDP was regressed over the national deficits, *GLS (1),* secondly adding regional security, *GLS(2)* and lastly adding neighboring conflicts, *GLS (3).* (see table 4),

Table 4: OLS multivariate panel regressions of defense expenditure on national deficit, regional security and neighboring conflicts

	GLS (1)	GLS (2)	GLS (3)
Variable	R-sq W/in 0.041 B.ween 0.001	R-sq W/in 0.079 B.ween 0.077	R-sq W/in 0.151 B.ween 0.123
def_pGDP	-0.267* (0.007)	-0.263* (0.029)	-0.214* (0.029)
r_security		38.884* (0.001)	24.313* (0.032)
n_conflict			30.934* (0.000)
_cons	136.823	90.191	71.166

*Note: the above regression is conducted by accordance with statistical significance *: P-value < 0.05 (5%)*

The three regressions in table 4 portray that national deficits as a percentage of GDP negatively impacts defense expenditure levels across all members. Intuitively, governments might reduce budgets due to the economic strain, putting them in a favorable position to free ride. The p-values of all coefficient are smaller than 0.05, the threshold adopted by this research, giving statistical significance to the results. We can be sure that the probability of the coefficients actually being null is close to, if not exactly, zero.

Additionally, what can also be observed from the table above, as we go from GLS(1) to GLS(3), is the increasing R-squared value while the variable coefficients decrease. This indicates that there are de facto more variables that, if take into the model, polish the results and accuracy of the statistical computation.

The other variables in this study are now added in the following regression models so that, as just mentioned, we can reach a higher level of accuracy in the research model.

Table 5: OLS multivariate panel regressions of defense expenditure on national deficit, regional security and neighboring conflicts, other defense commitments, country size and interaction effects.

	GLS (4)	GLS (5)	GLS(6)
Variable	R-sq W/in 0.224 B.ween 0.345	R-sq W/in 0.224 B.ween 0.334	R-sq W/in 0.236 B.ween 0.327
def_pGDP	-0.089 (0.336)	-0.091 (0.321)	-0.113 (0.222)
r_security	22.322* (0.040)	21.718* (0.048)	35.924* (0.010)
n_conflict	26.183* (0.000)	26.117* (0.000)	31.036* (0.000)
d_commit	-34.407* (0.000)	-34.353* (0.000)	-32.950* (0.000)
c_size		1.08 e-6 (0.788)	1.68 e-6 (0.685)
r_security x n_conflict			-30.433 (0.102)
_cons	125.585	125.407	104.465

*Note: the above regression is conducted by accordance with statistical significance *: P-value < 0.05 (5%)*

Table 5 depicts the regressions GLS(4) and GLS(5), where defense commitment and country size are added respectively to the previous regressions (table 4). As observed in table 4, variable coefficients decrease in absolute value, indicating that they all share statistically significant effect on a countries defense yearly budget.

Country size in GLS(5) is the only coefficient whose p-value largely exceeds the 5% threshold. Once more confirming what had been anticipated in the methodology section. Additionally, it appears that having polarized demographics, as do countries like Canada or Finland, do not significantly alter the countries potential GDP level. However, this analysis can be only effective in our ceteris paribus framework. This is because we previously assumed national GDP has a causal relationship with population size rather than country size. If this assumption were to be taken out, the results and analysis of this paper could be different.

The last column of table 5, GLS(6), adds the interaction effect between civil unrest and neighboring countries also obtained a statistically insignificant coefficient. Thus it appears that, if a country is already experiencing civil unrest, the government will not increase military budget with the causal of also having to be alert on troubles occurring across the border.

On the other hand, taken individually, these two variables positively affect the variable of interest in a statistically significant way. In all three regressions having local unrest increases defense expenditure of around: for each extra unit of GDP, defense expenditures increase from 22 to 35 USD. More, for every extra unit of GDP having neighboring conflict increases military expenditures of around 26 to 31 USD.

Fascinating for the purpose of this study are the coefficients regarding additional defense commitments taken by countries. Statistically significant, the coefficient negatively influence military budgets. This leads to think that military alliances can either increase free riding behaviors or, as argued for the first part of this research, more military alliances lay ground for peaceful times where an inflated military budget is not necessary.

National deficits also decrease the level of government spending for this sector, however, not by a large amount. The less-than-zero coefficients may be interpreted as deficits being of little importance during wartime, where governments prioritize national safety and victory over making ends meet in the budget.

According to the last regression model, GLS(6), a country which has civil unrest and/or neighboring countries, defense alliances and an economic deficit will always experience increased military expenditure than a country which is at peace. Thus, no matter if you have an alliance pact and are in economic distress, a government will enlarge the pipe of money given to the defense sector if in times of war.

In this research, the constant term reported throughout all regressions versions is not meaningful to the analysis. If all variables would be set to zero, NATO member states would still experience a degree of national budget being allocated to security and defense.

Overall, we continue on observing an increasing trend in the R-squared value. However, it's value – reaching a maximum of 0.236 within and 0.334 between – is not satisfactory. The R-squared quantifies the percent of explained variation from the model, hence this regressions were able to explain around 33% of the variance between variables. However, low R-squared values do not necessarily pose a problem in all researches, such cases include human based studies. This is because predicting human behavior is much more complex. Thus, as we obtained statistically significant individual variables, the study can carry out essential conclusions.

Nonetheless, other variables could be incorporated to increase R-squared values. Example being whether or not a country has a budget restriction or if a country faces scrutiny regarding its spending levels, such as Germany after the second world war.

Another plausible variable that could be incorporated is the actual allocation of the budgets. Whether or not countries concentrate their focus on personnel rather than machinery or innovation may have consequences on the levels of spending needed. As a matter of fact the times of peace instituted after the cold war perhaps nudged spending to go towards military labor force rather than heavy artillery designed for war. Adding this variable may add an additional layer on the decreasing trend in defense spending observed. An analysis of direct and indirect costs of personnel, depreciation and storage costs of the weaponry could also give insights on the channeling and cutting of costs.

Lastly, variables already used in this paper could potentially be refined and taken in a more detailed manner. *Regional_Security* and *Neighboring_Conflict* binary depict whether or not a country experiences local or bordering distress; refining these variables by also scaling the intensity of the war or civil unrest would perhaps result in a much more accurate regression outcome.

Conclusion

The North Atlantic Treaty Organization is to this day the strongest security and defense organization, which aims to foster the collective defense capabilities of members and ensure global stability and security. However, literature interprets alliances as pure public goods, with non-rival and non-excludable consumption, making them intrinsic with free riding behavior.

Under the banner of this organization, free riding behaviors reveals itself as uneven burden shares of military expenditures among members. The concept of free riding embodies the notion of enjoying security and defense benefits, otherwise unobtainable, on the expense of other member countries. As NATO moves forward and faces new difficulties, it results imperative to address the free riding issue which has also been the fulcrum of heated political debate in the past and – if not most importantly - still poses a threat to the cohesion and unification of NATO.

Thus, this paper observed NATO's members levels of defense expenditure starting 1960 to 2022. The research incorporated variables in order to create a temporal timeline which would still be valid as, country by country, the alliance expanded. More, the framework tried controlling for omitted variable bias and reverse causality by theoretical assumptions. The variables under scrutiny were essential in allowing this paper to dive deep in the complexities of geopolitics, economic policy and burden sharing asymmetries.

All historical literature point to the existence of free riding behavior of the smaller countries in the organization. However, the more complete framework in this research, depicts a negative trend in the overall military expenditure. The variables however shed light on how the decreasing spending average is not due to free riding behavior. The cause for such a trend is given by the current widespread geopolitical stability reached by the alliance compared to instable times in the past; this translated in lower spending levels: the absence of war didn't call for defense expenditures to soar.

A second interpretation given to the decreasing trend in expenditure is the level of security given to governments: knowing that if war were to unexpectedly erupt, given a countries normal amount of military budget, the alliance would provide secure military back up diverts heads of state of expanding defense budgets out of fear.

Moreover, the 2% target expenditure requirement set out from NATO seems to be efficient in stabilizing the expenditure level across members and, although the general average is still below 2%, countries have their military expenditures plateauing and fluctuated in a corridor rather than further decreasing for smaller countries, as the free riding dilemma would predict. As mentioned above, the 2% target on national GDP is

aimed at obtaining equitable contributions from all members. Thus, ceteris paribus, the expenditure behaviors have been following the target requested by NATO.

However, the chances of free riding are not eradicated. On the basis of the panel data, this research paper considers variables ranging from geographical factors, economic deficits, external defense commitments, to regional and neighboring security levels in order to measure the extent to which certain characteristics may affect the level of free riding behavior.

With statistically significant regression coefficients, this research found that regional unrest and neighboring conflicts are the largest determinants of increased military expenditure, alluring to the fact that when a country is not under threat or internal state of agitation it is more likely to under spend and free ride on the alliances behalf.

As variables are added to the framework, the coefficient of national debt got smaller until becoming statistically unsignificant. Hinting to the fact that national deficits are neglectable: in times of need, the defense sector would – regardless of economic strain – enlarge the spending amount. Accordingly, in times of peace, there still is a need of covering the basic costs to ensure security and defense levels.

Country size also resulted being futile when researching for free riding behavior as expected expenditure level are scaled to the national GDP levels, which in itself is correlated with a counties size. This paper assumed national GDP to be influenced by population size rather than country size, hence, allowing this variable to be introduced to the model. However, this might not necessarily hold, giving us a case of reverse causality. Nonetheless, results in GLS(5) and GLS(6) are consistent to the results from GLS(4), where country size was not included, making the analysis in this paper still relevant.

Moreover, the research leaves bitterness in statistically explaining the variance of the model. The contained R-squared level suggests that the framework has much potential to be upgraded and polished for better results and analysis.

None the less, this research paper builds on the strong literature revolving on the fervent debate of the free riding behavior among allies in the security and defense world. With the awareness of the global force of the NATO alliance, getting to the depths of the dilemma stays politically relevant so that the cohesion and the resilience of the organization can deepen. Perhaps unlocking NATO's true potential in forging the roadway towards securing international freedom and collective defense.

Bibliography

Cited

Gonzalez, R. A., & Mehay, S. L. (1991). Burden sharing in the NATO alliance: an empirical test of alternative views. *Public Choice*, *68*(1-3), 107-116. DOI: https://doi.org/10.1007/BF00173822

McCalla, R. B. (1996). NATO's Persistence after the Cold War. *International Organization*, *50*(3), 445–475. http://www.jstor.org/stable/2704032

Moran, M. (2019, December 5). Trump Is Right to Call Out Allies for Free-Riding on U.S. Military Might. Foreign Policy. https://foreignpolicy.com/2019/12/05/trump-right-alliances-free-riding-american-military-might-nato-japan-south-korea/

Murdoch, J. C., & Sandler, T. (1984). Complementarity, free riding, and the military expenditures of NATO allies. *Journal of public economics*, *25*(1-2), 83-101.https://doi.org/10.1016/0047-2727(84)90045-8

Nato. (n.d.). *Funding NATO*. NATO. DOI: NATO Funding

North Atlantic Treaty Organization (2023). Defence expenditure of member countries (2014-2022), *North Atlantic Treaty Organization.* DOI: https://www.nato.int/cps/en/natohq/news_212891.htm

North Atlantic Treaty Organization (2023). Information on defence expenditures, *North Atlantic Treaty Organization.* DOI: https://www.nato.int/cps/en/natohq/topics_49198.htm

Plümper, T., & Neumayer, E. (2015). Free-riding in alliances: Testing an old theory with a new method. *Conflict Management and Peace Science*, *32*(3), 247-268. https://doi.org/10.1177/0738894214522916

Sandler, T., & Hartley, K. (2001). Economics of alliances: The lessons for collective action. *Journal of economic literature*, *39*(3), 869-896.

The Economist. (2019, November 7). Emmanuel Macron warns Europe: NATO is becoming brain-dead. *The Economist*. https://www.economist.com/europe/2019/11/07/emmanuel-macron-warns-europe-nato-is-becoming-brain-dead

The World Bank, *World Bank Open Data.* Last accessed May 28th. DOI: https://data.worldbank.org/

Supporting

Adzinbaia Z. (2007) Nato in the Black Sea What to Expect Next? *North Atlantic Treaty Organization, NATO Defense College, Research Division*; DOI: http://www.ndc.nato.int/download/downloads.php?icode=533

Asmus, R. D., Kugler, R. L., & Larrabee, F. S. (1993). Building a New NATO. *Foreign Affairs*, *72*(4), 28–40. https://doi.org/10.2307/20045713

Brown, M. E. (1995). The flawed logic of NATO expansion. *Survival*, *37*(1), 34-52. DOI: https://doi.org/10.1080/00396339508442775

Brzezinski, Z. (2009). An Agenda for NATO: Toward a Global Security Web. *Foreign Affairs*, *88*(5), 2–20. http://www.jstor.org/stable/20699640

Daalder, I., & Goldgeier, J. (2006). Global NATO. *Foreign Affairs*, *85*(5), 105–113. https://doi.org/10.2307/20032073

Diehl, P. F. (1994). Substitutes or complements?: The effects of alliances on military spending in major power rivalries. *International Interactions*, *19*(3), 159-176.

Hartley, K., & Sandler, T. (1999). NATO burden-sharing: past and future. *Journal of peace research*, *36*(6), 665-680. DOI: https://journals.sagepub.com/doi/pdf/10.1177/0022343399036006004?casa_token=dv70ZlE-2WsAAAAA:rOmCLqgFFCHZBDcYdbshjg_V9ZBSN1j9ejqAiwnvYT4Jd6HfyBtcMys1b9TXJSvJ49hYmoyzcaod

Kaplan, L. A. (1969). The United States and the origins of NATO 1946–1949. *The Review of Politics*, *31*(2), 210-222.

Noetzel, T., & Schreer, B. (2009). Does a multi-tier NATO matter? The Atlantic alliance and the process of strategic change. *International affairs*, *85*(2), 211-226. DOI: https://doi.org/10.1111/j.1468-2346.2009.00790.x

North Atlantic Treaty Organization (2023). The Secretary General's Annual Report 2022, *North Atlantic Treaty Organization.* DOI: https://www.nato.int/cps/en/natohq/opinions_212795.htm?selectedLocale=en

Olson, Mancur and Richard Zeckhauser. 1966. "An Economic Theory of Alliances." Review of Economic Statistics 48: Oneal, J. R., & Diehl, P. F. (1994). The theory of collective action and NATO defense burdens: New empirical tests. *Political Research Quarterly*, *47*(2), 373-396.

Perlmutter, A., & Carpenter, T. G. (1998). NATO's Expensive Trip East: The Folly of Enlargement. Foreign Affairs, 77(1), 2–6. https://doi.org/10.2307/20048356

Sharp, J. M. (1990). Europe After an American Withdrawal. *Economic and.*

Sloan SR, National Defense University. Nato's Future : Toward a New Transatlantic Bargain. Washington, DC: National Defense University Press; 1985: 266–79

Appendix

Documentation of the member countries:

Member countries: Albania , Belgium, Bulgaria, Canada, Croatia, Czechia, Denmark, Estonia, France, Germany , Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Türkiye, United Kingdom, United States of America.

Table 6: Frequency Table of variable ex_pGDP

Value	Frequency	Value	Frequency
0,37	1	1.51	1
0,38	1	1.60	1
0,4	5	1.66	1
0,42	1	1.69	1
0,47	1	1.75	2
0,5	1	1.78	1
0,50	2	1.81	1
0,54	1	1.84	1
0,58	2	1.89	2
0,7	3	1.9,	1
0,8	3	1.97	2
0,81	1	1.98	1
0,86	1	2,00	5
0,88	2	2,01	3
0,89	4	2,02	4
0,9	5	2,03	2
0,90	1	2,05	1
0,91	3	2,06	4
0,92	1	2,07	2
0,93	3	2,08	2
0,94	3	2,1	3
0,95	1	2,10	2
0,97	3	2,11	1
0,98	1	2,12	1
0,99	1	2,13	1
0.67	1	2,2	7
0.78	1	2,21	1
0.80	1	2,22	3
0.97	1	2,23	1
1,00	1	2,26	1
1,01	1	2,3	6
1,02	2	2,30	2
1,03	2	2,31	1
1,04	2	2,34	1
1,05	1	2,35	1

1,06	2
1,07	1
1,09	1
1,1	20
1,10	4
1,11	4
1,12	1
1,13	1
1,14	3
1,15	4
1,16	5
1,17	1
1,18	3
1,19	3
1,2	12
1,20	4
1,22	5
1,23	3
1,24	3
1,25	2
1,27	3
1,28	2
1,29	1
1,3	13
1,30	7
1,31	2
1,32	2
1,33	4
1,34	4
1,35	2
1,37	3
1,38	2
1,39	2
1,4	25
1,40	3
1,41	2
1,42	2
1,43	1
1,44	4
1,45	4
1,47	1
1,48	1
1,49	1
1,5	16
1,50	4
1,51	1
1,53	1
1,54	1
1,55	4
1,56	1
1,57	1
1,58	1
2,36	1
2,38	1
2,4	2
2,40	1
2,42	1
2,45	1
2,5	1
2,50	1
2,54	1
2,6	4
2,7	1
2,8	2
2,9	1
2,90	1
2,91	1
2.04	1
2.10	1
2.13	1
2.15	1
2.19	1
2.20	1
2.25	2
2.26	1
2.31	1
2.35	1
2.37	1
2.45	1
2.55	1
2.67	1
2.70	1
2.73	2
2.77	1
2.78	1
2.79	1
2.80	1
2.86	1
3,1	2
3,13	1
3,2	4
3,29	1
3,30	1
3,31	1
3,47	1
3,51	2
3,52	2
3,6	1
3,66	1
3,70	1
3,72	1
3,76	1
3,9	1
3.00	1

1,59	4
1,6	14
1,60	4
1,61	1
1,62	2
1,64	1
1,65	1
1,67	1
1,68	1
1,7	5
1,70	1
1,71	3
1,72	2
1,73	3
1,74	1
1,75	2
1,76	1
1,77	1
1,78	3
1,79	1
1,8	11
1,80	1
1,81	3
1,82	3
1,84	1
1,85	1
1,86	4
1,89	1
1,9	7
1,90	3
1,91	1
1,93	1
1,95	1
1,97	1
1,98	1
1,99	2
1.04	1
1.05	1
1.17	1
1.23	2
1.26	1
1.32	1
1.33	1
1.35	1
1.38	1
1.42	1
1.45	1
1.47	1

3.01	1
3.06	1
3.11	1
3.12	1
3.14	1
3.16	1
3.20	1
3.21	1
3.25	1
3.30	1
3.35	1
3.41	1
3.61	1
3.68	1
3.88	1
3.91	1
4,1	3
4,2	1
4,3	1
4,4	1
4,9	2
4.02	1
4.15	1
4.24	1
4.60	1
4.71	1
4.90	1
4.96	1
5.03	1
5.23	1
5.70	1
5.92	1
6.16	1
6.47	1
7.52	1
8.77	1
9.83	1
4.90	1
4.96	1
5.03	1
5.23	1
5.70	1
5.92	1
6.16	1
6.47	1
7.52	1
8.77	1
9.83	1

Table 7: Tabulated data for each country and timelines utilized for the defense expenditures as percent of GDP

Country	Year	ex_pGDP	Country	Year	ex_pGDP
Albania	1960		Montenegro	1960	
Albania	1970		Montenegro	1970	
Albania	1980	5.70	Montenegro	1980	
Albania	1990		Montenegro	1990	
Albania	1995		Montenegro	1995	
Albania	2000		Montenegro	2000	
Albania	2005		Montenegro	2005	2.15
Albania	2009	1.50	Montenegro	2009	1.84
Albania	2010	1.60	Montenegro	2010	1.81
Albania	2011	1.50	Montenegro	2011	1.75
Albania	2012	1.50	Montenegro	2012	1.66
Albania	2013	1.40	Montenegro	2013	1.45
Albania	2014	1.34	Montenegro	2014	1.50
Albania	2015	1.16	Montenegro	2015	1.40
Albania	2016	1.10	Montenegro	2016	1.42
Albania	2017	1.11	Montenegro	2017	1.34
Albania	2018	1.16	Montenegro	2018	1.37
Albania	2019	1.28	Montenegro	2019	1.33
Albania	2020	1.30	Montenegro	2020	1.73
Albania	2021	1.22	Montenegro	2021	1.57
Albania	2022		Montenegro	2022	1.75
Belgium	1960	3.16	Netherlands	1960	3.68
Belgium	1970	3.01	Netherlands	1970	2.80
Belgium	1980	3.00	Netherlands	1980	2.78
Belgium	1990	1,90	Netherlands	1990	2.30
Belgium	1995	1.50	Netherlands	1995	1.30
Belgium	2000	1.30	Netherlands	2000	1.50
Belgium	2005	1.10	Netherlands	2005	1.50
Belgium	2009	1.20	Netherlands	2009	1.50
Belgium	2010	1.10	Netherlands	2010	1.40
Belgium	2011	1.10	Netherlands	2011	1.40
Belgium	2012	1.10	Netherlands	2012	1.30
Belgium	2013	1.10	Netherlands	2013	1.30
Belgium	2014	0.97	Netherlands	2014	1.15
Belgium	2015	0.91	Netherlands	2015	1.13
Belgium	2016	0.89	Netherlands	2016	1.16
Belgium	2017	0.88	Netherlands	2017	1.15
Belgium	2018	0.89	Netherlands	2018	1.22
Belgium	2019	0.89	Netherlands	2019	1.32
Belgium	2020	1.02	Netherlands	2020	1.41
Belgium	2021	1.04	Netherlands	2021	1.38
Belgium	2022	1.18	Netherlands	2022	1.65
Bulgaria	1960		North Macedonia	1960	

Bulgaria	1970	
Bulgaria	1980	
Bulgaria	1990	1.90
Bulgaria	1995	1.70
Bulgaria	2000	1.40
Bulgaria	2005	1.40
Bulgaria	2009	1.40
Bulgaria	2010	1.31
Bulgaria	2011	1.25
Bulgaria	2012	1.24
Bulgaria	2013	1.22
Bulgaria	2014	1.45
Bulgaria	2015	3.13
Bulgaria	2016	1,.0
Bulgaria	2017	1,.9
Bulgaria	2018	1.67
Bulgaria	2019	
Bulgaria	2020	
Bulgaria	2021	
Bulgaria	2022	
Canada	1960	3.25
Canada	1970	1.89
Canada	1980	1.98
Canada	1990	1.80
Canada	1995	1.30
Canada	2000	1.10
Canada	2005	1.20
Canada	2009	1.40
Canada	2010	1.20
Canada	2011	1.20
Canada	2012	1.10
Canada	2013	1.10
Canada	2014	1.01

North Macedonia	1970	
North Macedonia	1980	
North Macedonia	1990	
North Macedonia	1995	2.19
North Macedonia	2000	3.06
North Macedonia	2005	1.89
North Macedonia	2009	1.69
North Macedonia	2010	1.38
North Macedonia	2011	1.26
North Macedonia	2012	1.23
North Macedonia	2013	1.17
North Macedonia	2014	1.09
North Macedonia	2015	1.05
North Macedonia	2016	0.97
North Macedonia	2017	0.89
North Macedonia	2018	0.94
North Macedonia	2019	1.16
North Macedonia	2020	1.27
North Macedonia	2021	1.47
North Macedonia	2022	1.78
Norway	1960	3.35
Norway	1970	3.14
Norway	1980	2.77
Norway	1990	2.80
Norway	1995	2.20
Norway	2000	1.90
Norway	2005	1.50
Norway	2009	1.60
Norway	2010	1.50
Norway	2011	1.50
Norway	2012	1.40
Norway	2013	1.40
Norway	2014	1.55

Canada	2015	1.20	Norway	2015	1.59
Canada	2016	1.16	Norway	2016	1.74
Canada	2017	1.44	Norway	2017	1.72
Canada	2018	1.30	Norway	2018	1.73
Canada	2019	1.30	Norway	2019	1.86
Canada	2020	1.42	Norway	2020	2.00
Canada	2021	1.32	Norway	2021	1.75
Canada	2022	1.27	Norway	2022	1.55
Croatia	1960		Poland	1960	
Croatia	1970		Poland	1970	
Croatia	1980		Poland	1980	2.79
Croatia	1990	9.83	Poland	1990	2.37
Croatia	1995	7.52	Poland	1995	1.97
Croatia	2000	2.45	Poland	2000	1.80
Croatia	2005	1.51	Poland	2005	1.80
Croatia	2009	1.60	Poland	2009	1.70
Croatia	2010	1.60	Poland	2010	1.80
Croatia	2011	1.60	Poland	2011	1.80
Croatia	2012	1.50	Poland	2012	1.80
Croatia	2013	1.50	Poland	2013	1.80
Croatia	2014	1.82	Poland	2014	1.86
Croatia	2015	1.76	Poland	2015	2,22
Croatia	2016	1.60	Poland	2016	2.22
Croatia	2017	1.64	Poland	2017	1.89
Croatia	2018	1.55	Poland	2018	2.02
Croatia	2019	1.61	Poland	2019	1.98
Croatia	2020	1.71	Poland	2020	2.23
Croatia	2021	2.01	Poland	2021	2.22
Croatia	2022	2.03	Poland	2022	2.42
Czech Republic	1960		Portugal	1960	5.23
Czech Republic	1970		Portugal	1970	4.24
Czech Republic	1980		Portugal	1980	2.55
Czech Republic	1990	2.31	Portugal	1990	2.30
Czech Republic	1995	1.78	Portugal	1995	2.10
Czech Republic	2000	1.90	Portugal	2000	1.60
Czech Republic	2005	1.50	Portugal	2005	1.50
Czech Republic	2009	1.60	Portugal	2009	1.60
Czech Republic	2010	1.30	Portugal	2010	1.50
Czech Republic	2011	1.10	Portugal	2011	1.50
Czech Republic	2012	1.10	Portugal	2012	1.40
Czech Republic	2013	1.10	Portugal	2013	1.50

Czech Republic	2014	0.94
Czech Republic	2015	1.02
Czech Republic	2016	0.95
Czech Republic	2017	1.03
Czech Republic	2018	11.00
Czech Republic	2019	1.18
Czech Republic	2020	1.30
Czech Republic	2021	1.39
Czech Republic	2022	1.33
Denmark	1960	2.73
Denmark	1970	2.25
Denmark	1980	2.20
Denmark	1990	1.90
Denmark	1995	1.70
Denmark	2000	1.50
Denmark	2005	1.40
Denmark	2009	1.40
Denmark	2010	1.40
Denmark	2011	1.40
Denmark	2012	1.40
Denmark	2013	1.40
Denmark	2014	1.15
Denmark	2015	1.11
Denmark	2016	1.15
Denmark	2017	1.14
Denmark	2018	1.28
Denmark	2019	1.20
Denmark	2020	1.37
Denmark	2021	1.33
Denmark	2022	1.39
Estonia	1960	
Estonia	1970	
Estonia	1980	
Estonia	1990	
Estonia	1995	1.05
Estonia	2000	1.60
Estonia	2005	1.60
Portugal	2014	1.50
Portugal	2014	1.31
Portugal	2015	1.33
Portugal	2016	1.27
Portugal	2017	1.24
Portugal	2018	1.34
Portugal	2019	1.37
Portugal	2020	1.43
Portugal	2021	1.56
Portugal	2022	1.44
Romania	1960	
Romania	1970	
Romania	1980	3.20
Romania	1990	3.88
Romania	1995	2.73
Romania	2000	2.26
Romania	2005	1.60
Romania	2009	1.40
Romania	2010	1.30
Romania	2011	1.30
Romania	2012	1.20
Romania	2013	1.40
Romania	2014	1.35
Romania	2015	1.45
Romania	2016	1.41
Romania	2017	1.72
Romania	2018	1.81
Romania	2019	1.84
Romania	2020	2.02
Romania	2021	1.86
Romania	2022	1.99
Slovak Republic	1960	
Slovak Republic	1970	
Slovak Republic	1980	
Slovak Republic	1990	
Slovak Republic	1995	2.35
Slovak Republic	2000	1.75

Estonia	2009	1.80
Estonia	2010	1.70
Estonia	2011	1.70
Estonia	2012	2.20
Estonia	2013	2.20
Estonia	2014	1.93
Estonia	2015	2.03
Estonia	2016	2.07
Estonia	2017	2.01
Estonia	2018	2.02
Estonia	2019	2.05
Estonia	2020	2.35
Estonia	2021	2.07
Estonia	2022	2.34
France	1960	4.60
France	1970	3.21
France	1980	3.12
France	1990	3.30
France	1995	2.90
France	2000	2.50
France	2005	2.30
France	2009	2.10
France	2010	2.20
France	2011	1.90
France	2012	1.90
France	2013	1.90
France	2014	1.82
France	2015	1.78
France	2016	1.79
France	2017	1.78
France	2018	1.81
France	2019	1.81
France	2020	2.00
France	2021	1.91
France	2022	1.90
Germany	1960	4.02
Germany	1970	3.11
Germany	1980	2.86
Slovak Republic	2005	1.60
Slovak Republic	2009	1.50
Slovak Republic	2010	1.30
Slovak Republic	2011	1.30
Slovak Republic	2012	1.20
Slovak Republic	2013	1.40
Slovak Republic	2014	0.99
Slovak Republic	2015	1.11
Slovak Republic	2016	1.12
Slovak Republic	2017	1.11
Slovak Republic	2018	1.23
Slovak Republic	2019	1.71
Slovak Republic	2020	1.95
Slovak Republic	2021	1.73
Slovak Republic	2022	2.00
Slovenia	1960	
Slovenia	1970	
Slovenia	1980	
Slovenia	1990	
Slovenia	1995	1.42
Slovenia	2000	1.32
Slovenia	2005	1.47
Slovenia	2009	1.60
Slovenia	2010	1.60
Slovenia	2011	1.30
Slovenia	2012	1.20
Slovenia	2013	1.10
Slovenia	2014	0.97
Slovenia	2015	0.93
Slovenia	2016	1.00
Slovenia	2017	0.98
Slovenia	2018	1.01
Slovenia	2019	1.06
Slovenia	2020	1.06
Slovenia	2021	1.24
Slovenia	2022	1.22
Spain	1960	2.10
Spain	1970	2.25

Germany	1990	2.10
Germany	1995	1.60
Germany	2000	1.40
Germany	2005	1.30
Germany	2009	1.40
Germany	2010	1.40
Germany	2011	1.30
Germany	2012	1.40
Germany	2013	1.30
Germany	2014	1.19
Germany	2015	1.19
Germany	2016	1.20
Germany	2017	1.23
Germany	2018	1.25
Germany	2019	1.35
Germany	2020	1.53
Germany	2021	1.49
Germany	2022	1.44
Greece	1960	4.15
Greece	1970	4.90
Greece	1980	4.71
Greece	1990	3.90
Greece	1995	4.10
Greece	2000	3.20
Greece	2005	2.90
Greece	2009	3.20
Greece	2010	2.70
Greece	2011	2.40
Greece	2012	2.30
Greece	2013	2.30
Greece	2014	2.22
Greece	2015	2.31
Greece	2016	2.40
Greece	2017	2.38
Greece	2018	2.54
Greece	2019	2.45
Greece	2020	2.91
Greece	2021	3.70
Greece	2022	3.76
Hungary	1960	
Hungary	1970	3.30
Hungary	1980	3.41
Hungary	1990	2.13
Hungary	1995	1.35
Hungary	2000	1.70
Hungary	2005	1.30

Spain	1980	2.67
Spain	1990	1.60
Spain	1995	1.30
Spain	2000	1.20
Spain	2005	1.20
Spain	2009	1.20
Spain	2010	1.10
Spain	2011	1.10
Spain	2012	1.10
Spain	2013	0.90
Spain	2014	0.92
Spain	2015	0.93
Spain	2016	0.81
Spain	2017	0.91
Spain	2018	0.93
Spain	2019	0.91
Spain	2020	1.00
Spain	2021	1.04
Spain	2022	1.01
Türkiye	1960	3.41
Türkiye	1970	3.91
Türkiye	1980	3.61
Türkiye	1990	2.80
Türkiye	1995	3.20
Türkiye	2000	3.20
Türkiye	2005	2.20
Türkiye	2009	2.10
Türkiye	2010	1.90
Türkiye	2011	1.80
Türkiye	2012	1.80
Türkiye	2013	1.80
Türkiye	2014	1.45
Türkiye	2015	1.38
Türkiye	2016	1.45
Türkiye	2017	1.51
Türkiye	2018	1.82
Türkiye	2019	1.85
Türkiye	2020	1.86
Türkiye	2021	1.62
Türkiye	2022	1.22
United Kingdom	1960	6.47
United Kingdom	1970	5.03
United Kingdom	1980	4.96
United Kingdom	1990	3.60
United Kingdom	1995	2.60
United Kingdom	2000	2.30

Hungary	2009	1.20
Hungary	2010	1.10
Hungary	2011	1.10
Hungary	2012	1.10
Hungary	2013	0.90
Hungary	2014	0.86
Hungary	2015	0.90
Hungary	2016	1.00
Hungary	2017	1.19
Hungary	2018	1.01
Hungary	2019	1.34
Hungary	2020	1.77
Hungary	2021	1.66
Hungary	2022	1.55
Italy	1960	2.70
Italy	1970	2.04
Italy	1980	1.97
Italy	1990	2.20
Italy	1995	1.90
Italy	2000	2.20
Italy	2005	1.60
Italy	2009	1.40
Italy	2010	1.40
Italy	2011	1.40
Italy	2012	1.30
Italy	2013	1.20
United Kingdom	2005	2.50
United Kingdom	2009	2.50
United Kingdom	2010	2.60
United Kingdom	2011	2.60
United Kingdom	2012	2.80
United Kingdom	2013	2.40
United Kingdom	2014	2.13
United Kingdom	2015	2.01
United Kingdom	2016	2.06
United Kingdom	2017	2.06
United Kingdom	2018	2.08
United Kingdom	2019	2.06
United Kingdom	2020	2.80
United Kingdom	2021	2.26
United Kingdom	2022	2.12
United States	1960	8.77
United States	1970	5.92
United States	1980	6.16
United States	1990	4.30
United States	1995	3.10
United States	2000	3.10
United States	2005	4.10
United States	2009	4.90
United States	2010	4.90
United States	2011	4.40
United States	2012	4.20

Italy	2014	1.14
Italy	2015	1.07
Italy	2016	1.18
Italy	2017	1.20
Italy	2018	1.23
Italy	2019	1.17
Italy	2020	1.59
Italy	2021	1.58
Italy	2022	1.54
Latvia	1960	
Latvia	1970	
Latvia	1980	
Latvia	1990	
Latvia	1995	0.67
Latvia	2000	1.33
Latvia	2005	1.40
Latvia	2009	1.20
Latvia	2010	1.10
Latvia	2011	1.10
Latvia	2012	0.90
Latvia	2013	0.90
Latvia	2014	0.94
Latvia	2015	1.03
Latvia	2016	1.44
Latvia	2017	1.59
Latvia	2018	2.06
Latvia	2019	2.02
Latvia	2020	2.21
Latvia	2021	2.11
Latvia	2022	2.10
Lithuania	1960	
Lithuania	1970	
Lithuania	1980	
Lithuania	1990	
Lithuania	1995	0.78
Lithuania	2000	1.23
Lithuania	2005	1.10
Lithuania	2009	1.10
Lithuania	2010	0.90
Lithuania	2011	0.80
Lithuania	2012	0.80
Lithuania	2013	0.80
Lithuania	2014	0.88
United States	2013	4.10
United States	2014	3.72
United States	2015	3.52
United States	2016	3.52
United States	2017	3.31
United States	2018	3.29
United States	2019	3.51
United States	2020	3.66
United States	2021	3.51
United States	2022	3.47

Lithuania	2015	1.14
Lithuania	2016	1.48
Lithuania	2017	1.71
Lithuania	2018	1.97
Lithuania	2019	2.00
Lithuania	2020	2.08
Lithuania	2021	2.00
Lithuania	2022	2.36
Luxembourg	1960	1.04
Luxembourg	1970	0.80
Luxembourg	1980	0.97
Luxembourg	1990	0.70
Luxembourg	1995	0.70
Luxembourg	2000	0.70
Luxembourg	2005	0.50
Luxembourg	2009	0.40
Luxembourg	2010	0.40
Luxembourg	2011	0.40
Luxembourg	2012	0.40
Luxembourg	2013	0.40
Luxembourg	2014	0.37
Luxembourg	2015	0.42
Luxembourg	2016	0.38
Luxembourg	2017	0.50
Luxembourg	2018	0.50
Luxembourg	2019	0.54
Luxembourg	2020	0.58
Luxembourg	2021	0.47
Luxembourg	2022	0.58

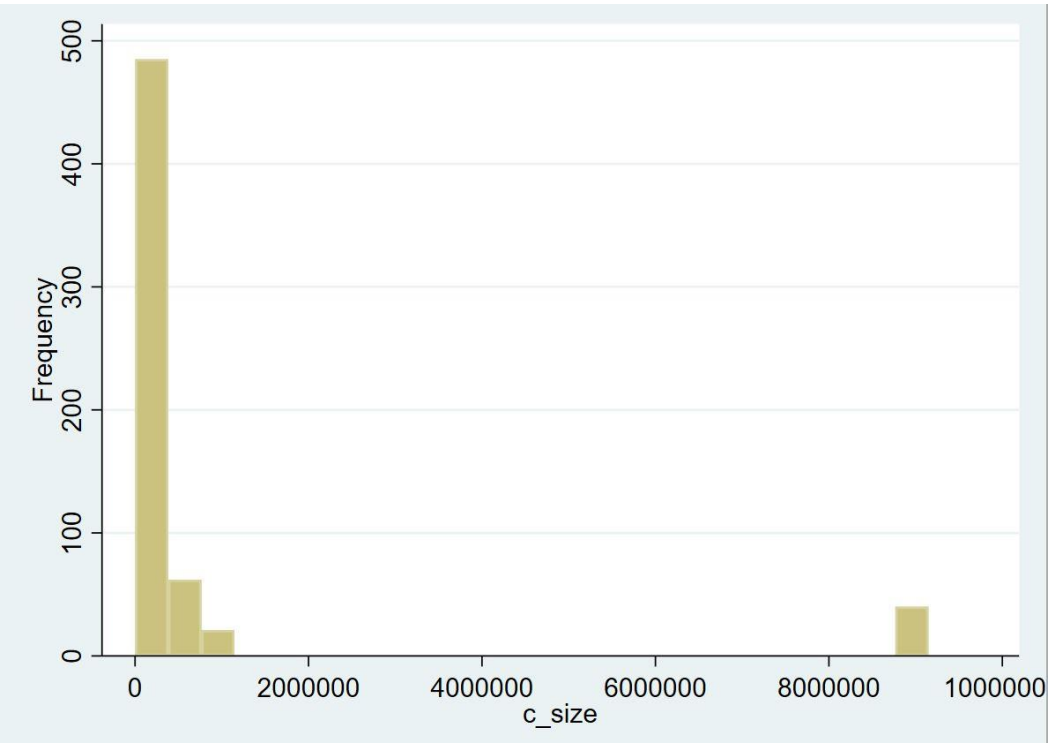

Figure 1: Histogram of frequency for the NATO member countries sizes, showing left skewness

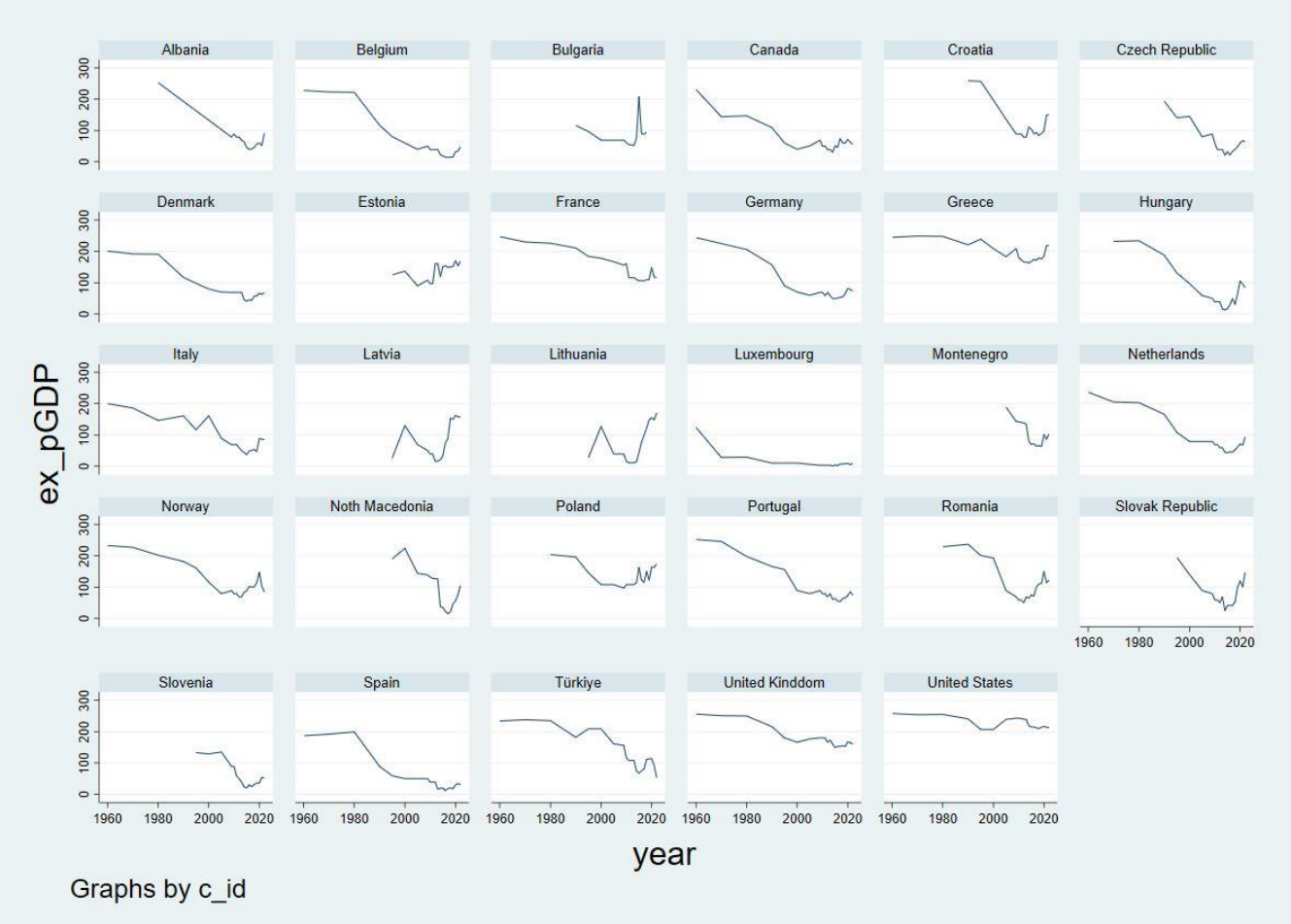

Figure 2: Plotting of defense expenditure levels as a percentage of GDP per member country from 1960 to 2022

Table 8: Used Stata Commands for research paper

```
 *// Grab data from excel spreadsheet previously collected and put into long version//
ed

* //Rename all variables to their items//
{
rename var1 country
rename var2 year
rename var3 Defense_expenditures_pGDP
rename var4 Deficit_pGPD
rename var5 Defense_Committments
rename var6 Country_Size
rename var7 Regional_Security
rename var8 Neighbouring_Confict
}
* descriptive stats
describe
tab Neighbouring_Confict
tab Country_Size
tab country
tab


* Edit String Values
// Understand what type of data you have // use to describe all variables >

> // Transform country sting names to lables // give each country a compid value//
encode country, generate (c_id)
egen compid = group (country)

//Adjust time errors for gap years: unbalanced data
 drop if year == year[_n-1]

 *edit other data
 //defense expenditures over the years
 encode Defense_expenditures_pGDP, generate (ex_pGDP)

//contry size, with dummy variables
destring Country_Size, generate (c_size)
gen c_large = c_size >= 700000
gen c_medium = ((c_size > 400000) & (c_size < 700000))
gen c_samll = c_size <= 400000
sum

//deficits over the years
destring Deficit_pGPD, generate (def_pGDP) percent

//presence of other alliances or commitments
encode Defense_Committments, generate (d_commit)

```

```
//regional security and neighbouhood safety
encode Regional_Security, generate (RSecurity)
egen n_conflict = group (N_Conflict)

* State panel data
xtset c_id year

* Observe the setted data
{
    tab c_large
    tab c_medium
    tab c_samll
    tab n_conflict
    tab def_pGDP
    tab RSecurity
    tab d_commit
    tab deficits

}

*Obtain variables graphs
histogram def_pGDP in 1/608, frequency
```

```
//Multiple GLS regressions
xtreg ex_pGDP def_pGDP
xtreg ex_pGDP def_pGDP RSecurity
xtreg ex_pGDP def_pGDP RSecurity n_conflict
xtreg ex_pGDP def_pGDP RSecurity n_conflict d_commit
xtreg ex_pGDP def_pGDP RSecurity n_conflict d_commit
c_size
xtreg ex_pGDP def_pGDP RSecurity n_conflict d_commit
RSecurity##n_conflict
```

Word Bank

c_id = country id number given on STATA

compid = country names transformed from string to numeric

Country_Size = square kilometer value of the size of each country

d_commit = numeric binary value of yes/no on if a country has another military commitment apart from the NATO alliance

def_pGDP = numeric value of national deficit as a percent of GDP

Defense_Committments = string binary value of yes/no on if a country has another military commitment apart from the NATO alliance

Defense_expenditures_pGDP = string value of a countries amount of defense expenditure as a percentage of national GDP

Deficit_pGPD = sting value of national deficit as a percent of GDP

ex_pGDP = numeric value of a countries amount of defense expenditure as a percentage of national GDP

n_conflict = numeric binary value yes/no on if a neighboring country is under military distress

NATO : North Atlantic Treaty Organization

Neighbouring_Confict = string binary value yes/no on if a neighboring country is under military distress

OVB : Omitted variable bias

Regional_Security = string binary value safe/unrest on if a country is under military or political distress

RSecuity = numeric binary value safe/unrest on if a country is under military or political distress

USD : U.S. Dollar