From the Technical and Tactical to the Legislative and Political:

The Effects of Military Expenditure on Economic Growth

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# Technical & Tactical to the Legislative & Political: The effects of Military expenditure on Economic Growth

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1.1 INTRODUCTION

“According to standard industry accepted economic forecasting, the multirole 5th generation stealth fighter is responsible for more than 129,000 direct and indirect jobs, making it the single largest job generator in the Department of Defense budget.”

-The above is an excerpt from Lockheed Martin’s official F-35 Joint Strike Fighter program's public information package (Lockheed Martin, 2014).

The Lockheed Martin Joint Strike Fighter Program is according to best estimates today over seven years delayed since it’s start in 1997 and 163 Billion USD over it’s budget (more than twice the cost of the Apollo and Gemini program). In addition to development, the Pentagon plans to purchase 2,400 units at a total cost of 400 Billion USD (lifetime costs not included) (Martin, 2014).

When governments produce budgets to finance their programs they are always confronted with the dilemma of determining how to prioritize limited assets. These are typically highly politicized topics of debate in common policy making (Mattson et al., 2011). Often costly programs are criticized as wasteful and/or unnecessary, meaning that they are unjustified and hence ought be shut down. Such arguments are sometimes countered by arguing that the positive dynamic effects generated by said programs will outweigh the costs incurred in time. With stakes as high as in the aforementioned example it’s safe to say that these sort of policy decisions are important. Which is why it’s important to back statements as bold as the one mentioned above with, if not scientific proof, then evidence.

The problem with such an argument is that dynamic effects are extremely hard to either quantify, isolate, or compare. The "dynamic effects” argument is therefore very difficult to falsify, which implicitly weakens such claims. In this paper I will investigate one specific field frequently encompassed by such claims; namely the effects of military expenditure on economic growth.

The primary reason for why military expenditures are interesting is because they are such a common feature of government budgets and typically encompass a relatively large share of the total budget. Military expenditures are neither isolated events in time nor geographically either allowing for a wealth of observations.
This paper will focus exclusively on current member countries of the North Atlantic Treaty Organization. These countries share a number of common denominators, ranging from legislative, trade unions, historical and economic and most notably, in their defense policies (Nato, 2014b), having largely standardized their armed forces with regards to both hardware, standard operating procedures and doctrine. This helps us further simplify a comparison between countries. Further this study focuses on a specific time span, starting the year 1980 and ending year 2013. This is simply due to the data which I have had access to.

1.2 PURPOSE

The purpose of this paper is to see if military expenditure can as a factor, can help explain economic growth among Nato nations. To accomplish this I will attempt to build a growth model spanning a five year period, based on a by Robert Barro (Barro, 1997) specified model.

The purpose can therefore be surmised as, to by means of linear regression, based on Robert Barro’s growth model, check to find an either positive, negative or nonsignificant-correlation between military expenditure (expressed as a share of GDP) and economic growth among Nato nations.

When this is done we will be able to say something about the effects that military expenditure have on a nations economy. By being able to either attribute the effects to military expenditure or not, and if there in fact is a measurable effect, will it be positive or negative?

1.3 DELIMITATIONS & DEFINITIONS

Military Expenditure

The first delimitation is the definition of military expenditure, since the purpose of this paper is to investigate the effects of military expenditure on the greater national level of economy. In this study military expenditure will be defined as it is by the Stockholm International Peace Research Institute (Sipri).
“The SIPRI definition of military expenditure aims to include all spending on current military forces and activities”

This measure includes (but is not exclusive to)
- Armed forces, including peacekeeping forces
- Defense ministry(s)
- Paramilitary force(s)
- Procurement/research and development (R&D)
- Civil defense
- Veterans' benefits
- Mobilization and demobilization

Finally military expenditures will be expressed as a percentage share of GDP.
(Sipri, 2014)

Growth
Growth is in this study defined as the percentage growth of an annual Gross Domestic Product (GDP) over a five year period. Where GDP is defined as the sum value, of all goods and services exchanged within a country's geographical borders. The purpose of a five year period is to allow for a greater range of dynamic effects from defense expenditure to come into effect. The five year time period will begin the year in which the (military) expenditures were made and end with the fifth consecutive observation.

Time
The third delimitation of this paper is that of time. All in all the observations are on an annual basis, spanning from the year 1980 to the year 2013. The reason for choosing this time period is partially for the sake of obtaining relevant data in order to conduct this study, but primarily because this is the latest and therefor most relevant timespan to study for modern law-policy- and decision- makers.

Sample-Population
The fourth and final delimitation for this paper will be that defining the sample population. I will use (practically) a full population sample of the member states of the North Atlantic Treaty Organization (Nato) with the exception of Iceland. Simply due to the fact that Iceland (uniquely among Nato nations) lacks standing armed forces, constituting a key defining portion of military expenditure.

2 BACKGROUND

2.1 A REVIEW OF PREVIOUS RESEARCH

The idea of using military expenditures as a determinant for predicting future growth is not a new one. The idea is encompassed by a field of economics called “Defense Economics” and has been explored by a number of prominent researchers prior to this study. First of all, results from previous work vary. That said published research findings so far have not been conclusive, meaning that the topic is still debated within the scientific community.

An early example of research in this field was done by Emile Benoit. An often quoted piece of Benoit’s work is "Growth Effects of Defense in Developing Countries" (Benoit et al., 1972). In this Study Benoit uses data from 44 “less developed countries” from the period of 1950 to 1965, and compares their military expenditures with the growth of GDP. Benoit’s findings pointed towards there being a significant and positive effect of military expenditure on growth. Benoit thereby stunned the scientific community by ultimately concluding said positive relationship. Benoit was one of the the earlier researches to dig into this field and has been used as a starting point for many researchers in the field of Defense Economics to branch off of. A noteworthy fact though, is that Benoit’s findings can not be replicated by later researchers when the same model is applied on other time periods (Grobar and Porter, 1989).

Since Benoit the, field of defense economics has branched out into a wide field of studies, with researchers using a broad field of methods and strategies for their studies, for widely different purposes as well. An example of a researcher who built a model for a very narrow purpose is Ron Smith.

Ron Smith’s purposes are more specific than what I intend for this study. Ron Smith constructed a demand sided growth model in which he included military expenditure, in order to check for
any significance. Smith’s work differs from many others in the sense that he specifically sought to test what the size and significance of the crowding out effects were of military expenditure. Although the purpose of his model is somewhat different from mine, his work is still relevant in this context. The contrast from his study being that his model is built entirely from the perspective of Keynesian aggregate demand. While this view still is relevant in my study and results can be interpreted through those theories (Smith, 1980).

A more recent study done by M. Stroup and J. Heckelman is perhaps the most similar to what I intend to create in this study. Stroup and Heckelman attempted to incorporate the defense sector into a growth model. The purpose of this was to attempt to see whether the size of the defense sector was relevant to the growth of an economy. They ultimately went about this by using an already proven growth model as a base to build off of. The model they built off of was built by a Robert Barro (who will be discussed more closely in section 2.2). Stroup and Heckelman concluded that military expenditure generally had a negative effect on growth, while at the same time military expenditures could in some countries have a positive effects on the labour force in countries, when the initial level of education was low. Likewise military expenditures could in a few cases have a positive effect on growth in countries with very low levels of initial GDP/ Capita (Stroup and Heckelman, 2001).

As these examples show conclusions do vary. This leaves a stark imprint on literature in the field, as findings are often characterized as inconclusive, due to the simple fact that results can vary so greatly. In the book “The Economics of Defense” however T. Sandler and K. Hartley suggest a pattern of how the overwhelming majority of demand based models indicate a negative effect on growth from Military Expenditure and supply based models tend to show a positive relationship (Sandler, 1995, p.215). Further Sandler and Hartley suggest that there may also be a connection between “lesser developed countries” and positive effects from Military Expenditure but even so they add, that this would unlikely carry over to a developed economy.

2.2 BARRO

For this study however the perhaps most influential previous work comes from Robert Barro. I will be drawing from one specific slice of his publications, namely Determinants of Economic
Growth: A Cross-Country Empirical Study (Barro, 1997). In which Barro specifies a model for growth and what factors are appropriate to take into account in a growth model. This includes among others, factors like education, the size of the government, fertility and child mortality rates.

Barro’s growth models are widely accepted and utilized by researchers, among others Stroup and Heckelman (2001) and Aizenman and Glick (2006).

The Barro growth model will serve as the base in this study, in building a growth model incorporating military expenditure and will be explained with greater detail later on.

3 THEORETICAL FRAMEWORK

Military expenditure can affect the characteristics of an economy in a vast number of ways. That said, there are multiple defined channels through which previous studies have confirmed military expenditures effect the greater economy. In this study we will however rely on three primary mechanisms as explanations for the generated results of the model, namely human capital, technological spillover and crowding-out. These are the effects of military expenditures which I will base the analysis on.

3.1.1 HUMAN CAPITAL

Human capital in this context is defined as skills applicable by the individual laborer towards sustaining oneself, in this context that means gaining either employment or self employment. In our context human capital is relevant because we can find very clear connections between human capital investments and military expenditures. Since defense and military activities require (varying) degrees of competence within the labour force, militaries and defense agencies must invest heavily in teaching their workforce the trades required to execute their respective tasks. An implication of this is that military service typically requires an increase in the general level of human capital. Given that the defense related labour force can constitute a significant portion of the total national labour force, the effects on the greater national workforce could potentially be significant, provided that the skills acquired by the military workforce are transferable to the civil labour market (Becker, 1975).
This is however not always the case. Studies have shown that the transferability depends on what sort of job and training a worker was positioned as (Binkin, 1979). Many of the skills taught in this context are exclusive to the military environment, making these skills harder to come by in the greater workforce. Potentially working in both ways for the worker, either making their skills more valuable or rendering their skills nontransferable. In this study I am going to make the assumption that by and large the net human capital added is transferable to the civil sector of the economy. That is, the average military/defense sector veteran can to a significant degree utilize the competences acquired in the military or other defense agency, in a civil career.

3.1.2 NEW TECHNOLOGY

Procurement is an important aspect of the economic impact of military expenditure. This is because the process through which equipment and technology is procured often involves inventing new technology and designs. Therefore the military or other defense agencies strive to incentivize research and development within relevant fields of industry. The exact method of procurement may vary but typically involve a process in which competitions with specific product requirements are announced, in which potential suppliers compete by means of both bidding and their product quality (Peck and Scherer, 1962). The important principle at play here is the potential for spillover effects, both from awarded contracts and rejected ones. The point being that regardless of if the military or other other defense agency decide to procure an idea or invention, the invention has by definition already been invented, hence a spillover effect can still occur at reasonable cost (Hall and Johnson, 1967). As shown by (Bernstein and Nadiri, 1989) spillover effects within an industry are not only possible but are significant, going as far as to state that industry spillover effects can significantly help save costs, thanks to general spread of knowledge and restructured production functions. Bernstien and Nadiri show that although the trends vary in magnitude, all sectors still show positive net effects.

Since both awarded and rejected contracts, as well as the private and government sectors can produce spillover effects, there’s no reason to believe these effects can’t aggregate to a degree measurable on a macroeconomic scale
3.1.3 CROWDING OUT
A possible negative effect of military expenditure is the risk for crowding out. Crowding out is a term coined to explain the phenomena when government bidding competes with the private sector for production factors (land, labour, capital), thus increasing demand and driving up prices. Ultimately knocking out (at least) some private sector bidders out of the market. Needless to say this has a depressive effect on the economy. These mechanism are fundamentally captured in Keynesian models in portraying a non optimal allocation of assets. The problem is further catalyzed by that fact that “defense” or “military services” (as goods and/or services) are not consumed in a typical consumer-demand sort of fashion as opposed to for example health care or other civil services. Meaning that the assets spent are both crowding out other civil investments as well as not yielding utility for the taxpayer. This effect is investigated closely by Ron Smith, who as mentioned previously was able to determine that crowding out indeed had a significant effect (Smith, 1980).

This sort of reasoning builds heavily off of Keynes aggregate demand, which comprises the main perspective through which the crowding out mechanism is typically studied through. However if crowding out is in fact an issue we still ought to be able to potentially observe it in this study.

3.2 MILITARY EXPENDITURE - SURMISED
These effects are as defined by previous researchers very real channels through which the greater national economy can be affected by military expenditures, and as previous researchers show, they infact all do to a degree. What the net effect will become is however somewhat of an ambiguous question to answer as these effects work in different directions. However because Military Expenditures account for such a large part of the economy it would be presumptuous to neglect military expenditure when trying to estimate future growth. Thus predicting the characteristics of a coefficient for such a variable in a growth model would defeat much of the purpose of this paper, as determining said characteristics is more or less (as stated in the purpose formulation) the purpose of this study.

3.3 THE BARRO MODEL
This study (as mentioned earlier) draws heavily on the work done by Robert Barro in specifying growth models. Specifically this paper will draw off of a piece of work from Robert Barro titled "Determinants of Economic Growth" (Barro, 1997). Barro’s growth models are commonly used and generally accepted within the research community and have been used in previous studies concerning defense economics such as (the previously mentioned) Stroup and Heckelman (2001) and Aizenman and Glick (2006) as well as in studies not directly related to defense economics like "Inequality and Growth", by Barro himself (Barro, 2000). The variables included by Barro are grounded primarily in production based theories. These theories allow us to specify a range of variables in regards to their respective theoretical category. These categories include Initial Income, the Size of Government, Education, Fertility and Investment. Barro also includes a number of indicator variables which concern toll & trade unions, weather or not a country can be considered democratic, and regional indicators as well.

### 3.4 DYNAMIC CHANGE OVER TIME

There is however a further complicating factor at play here. That is, both Nato as an organization (and in its separate constituent nations) have due to specific global events, been forced to drastically change and reevaluate its strategies and ways in which it as an organization manages security. Here I am referring to the fall of the Soviet Union and the 9/11 World Trade Center attacks (9/11) which lead to the ensuing War on Terrorism. This ever changing dynamic is highlighted by Joseph Nye in his book Understanding global conflict (Nye, 2013, p.245-273), which examines how the fall of the Soviet Union affected the global interdependency forcing nations and organizations to rethink and reshape their strategies.

A further game changing events for Nato was of 9/11, triggering the first ever in history activation of Nato's Article 5, the obligation of each member nation to commit to collective defense (see paragraph 4.1). Which once again, within the span of a rough decade forced Nato to rethink itself (Gordon, 2001).

These changes have lead to considerable restructuring and reorganization on many levels from as low as the technical and tactical to as high as the legislative and political. Effecting everything along the spectra from how and for what grunts train, to what sort of equipment and technology
the higher echelons of decision makers demand and acquire. Both ends of this spectra carry very clear implications in how the by previous researchers, defined channels of effect will determine growth. Thus we will have to account for these changes when conducting our study.

4 RESEARCH STRATEGY - METHOD
4.1 SAMPLE POPULATION - CASE SELECTION

Regarding regions to compare I have chosen to make these comparisons on a national level. As stated earlier, this study is focused on 26 of the countries included in Nato (Iceland excluded as the nation lacks a standing military). The reason for this being primarily that of homogeneity. The Nato member countries are almost exclusively western countries and have today developed economies. But the homogeneity is above all significant in regards to the design and organization of these country's armed forces. This is due to several reasons. The first being that Nato requires its constituent nations to sign onto a common charter, concerning defense requirements. This being the founding the principle of collective defense. All countries are thereby required to contribute a minimum portion of their GDP towards military defense expenditures in order to assert territorial integrity. As well as requiring its member countries to pre obligate themselves to collective defense, as pledged in article 5 of the Washington Treaty (Nato, 2014a). In which it is stated that in the event of a member nation being confronted by armed aggression, all other member countries are fully committed to assisting and protecting said nation. The Washington Treaty serves to align long term military-strategic and political-policy objectives, among Nato countries.

These mission statements require the militaries of Nato Member countries to be able to work together in a war and combat environment, creating a need for compatibility (interoperability). Hence Nato has instated (and continues to instate) a long list of STAndardized Nato AGreements (STANAGs). These STANAGs concern a broad range of matters including (but not exclusive to) hardware, standard operating procedures, terminology as well as other non directly militarily related matters (Nato, 2014b).
All these factors together lead me to the conclusion that today's Nato countries military and general defense structures are similar (homogenous) enough to make direct comparisons amongst.

The advantage of using such a narrow slice of countries is that of homogeneity, that is should we observe a general relationship (or lack of) between defense expenditure and effects on growth, causality could be a reasonable explanation. Had we not had any logical parallels or similarities, arguing causality would be a steep uphill battle.

In essence what I am doing by narrowing down an observation group is sacrificing generality for for causality.

From this collection of 26 countries I will construct a set of panel data, spanning 33 years (1980-2013) based on the by Barro specified variables and military expenditure in order to conduct a quantitatively based study. With said panel-data I will then conduct a variant of an ordinary least squares (OLS) multiple linear regression.

4.2 EMPIRICAL MODEL

The model used in this study will have it's starting point in the same sort of Barro-type growth model as used by Stroup and Heckelman’s work in “Size of the Military Sector and Economic Growth” (Stroup and Heckelman, 2001). Which are in turn based on a growth model specified by Robert Barrow in “Determinants of Economic Growth” (Barro, 1997). The work of Robert Barro has served as a base, which has been applied to a wide range of growth related topics, as Barro's models are typically general and robust. Barro bases his models on a combined list of theories from which he then asserts proxies to reflect his assumptions. Originally Barro specified a large number of proxies which could be used together, but later researchers only use single proxies to reflect each respective theory. Which was what was done in the case of Stroup and Heckelman (2001), with the simple augmentation of adding military expenditure as a final additional variable to Barro’s model and using fewer proxies, which is what I intend to do here.

In Robert Barro’s book Determinants of Economic Growth (1997), Barro specifies a model for specifically predicting GDP/Capita growth. Where he demonstrates the all of his proxy variables
applied to a panel of roughly 100 countries. The model then yielded an outcome as the one shown below.

The typical Barro model includes a further number of variables to account for a number differences between the observed individuals (nations), such as democracy indices, type of economy, regional or weather a country is a part of a trade union or not. However in this population such variables would be tautological as the population of countries are largely homogenous by these criteria. Therefore I made the decision to not include many of these variables, with the one exception of weather a country is part of the European Union or not. Thereby I will attempt to replicate the sort of simplified Barro typed model similar to the one used by Stroup and Heckelman.

I will additionally include a variable in order to account for the over time dynamic nature of military expenditure. Here I am referring to the reorganization of and reevaluation of the nature

<table>
<thead>
<tr>
<th>Indépendant variable</th>
<th>Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP/Capita</td>
<td>-0.0225</td>
<td>0.0032</td>
</tr>
<tr>
<td>Male secondary and higher schooling</td>
<td>0.0098</td>
<td>0.025</td>
</tr>
<tr>
<td>Life expectancy</td>
<td>0.0418</td>
<td>0.0139</td>
</tr>
<tr>
<td>GDP*Male Schooling</td>
<td>-0.0052</td>
<td>0.0017</td>
</tr>
<tr>
<td>Fertility Rate</td>
<td>-0.0135</td>
<td>0.0053</td>
</tr>
<tr>
<td>Government Consumption Ratio</td>
<td>-0.115</td>
<td>0.027</td>
</tr>
<tr>
<td>Rule of Law Index</td>
<td>0.0262</td>
<td>0.0055</td>
</tr>
<tr>
<td>Terms of Trade Change</td>
<td>0.127</td>
<td>0.030</td>
</tr>
<tr>
<td>Democracy Index</td>
<td>0.094</td>
<td>0.027</td>
</tr>
<tr>
<td>Democracy Index Squared</td>
<td>-0.91</td>
<td>0.024</td>
</tr>
<tr>
<td>Inflation Rate</td>
<td>-0.039</td>
<td>0.008</td>
</tr>
<tr>
<td>Regional Dummies</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The typical Barro model includes a further number of variables to account for a number differences between the observed individuals (nations), such as democracy indices, type of economy, regional or weather a country is a part of a trade union or not. However in this population such variables would be tautological as the population of countries are largely homogenous by these criteria. Therefore I made the decision to not include many of these variables, with the one exception of weather a country is part of the European Union or not. Thereby I will attempt to replicate the sort of simplified Barro typed model similar to the one used by Stroup and Heckelman.
of security following the fall of the Soviet Union (in the early 90s) and 9/11 (in the early 2000s) described by Joseph Nye (Nye, 2013) and Phillip Gordon (Gordon, 2001) respectively.

The model that will be used is a linear regression model for panel-data. The independent variables consist of the initial level of GDP/Capita ($Y$), non-military and non-education related government expenditure ($X_2$), education related government expenditure ($X_3$), the average women's fertility ($X_4$), gross capital formation ($X_5$), the sum of military expenditure ($X_6$), a interaction variable denoting the size of the military expenditures and weather or not they were made in the 1990s ($X_7$), a interaction variable denoting the size of the military expenditures and weather or not they were made during the 2000s ($X_8$), and finally an indicator for weather the observed nation is a member of the European Union ($X_9$). Further the model includes an individual specific time invariant error term (denoted $\theta$) this could be thought of as a sort of dummy consisting of the average of the given $X$-values which can then be subtracted, thus eliminating the time-invariant characteristics leaving only the “time-variant” effects. For these reasons one does not directly observe this error term. It is in this regard that this model differs from a non panel-based model. Another way you could express this is that the classical error-term used in non-panel data regressions is split into two parts. where one is the constant or time invariant characteristics, which which we can then work with (this will be discussed closer in segment section 4.4). This is yet another way in which the panel structure of the data effects the econometric specification.

See Table 2 and Equation 1 for an overview of the econometric specification.

$$y_{it}=\beta_0+\beta_1Y_{it(-1)}+\beta_2X_{2it}+\beta_3X_{3it}+\beta_4X_{4it}+\beta_5X_{5it}+\beta_6X_{6it}+\beta_7X_{7it}+\beta_8X_{8it}+\beta_9X_{9it}+\theta_i+\epsilon_i$$

Equation 1: Regression Equation
Furthermore the model will in fact be run with fixed effects. Econometrically this means that we are accounting for the time-invariant characteristics (or fixed effects) of each nation from the will be removing model. This helps us control for any sort of unobserved heterogeneity among the individuals, which we suspect exist. (The fixed effects are more closely defined in segment 4.4 Model Fitting)

### 4.3 THEORIES AND COEFFICIENTS - HYPOTHESES

In this segment I intend to state the hypothesis and associated motivation for each variable included in my regression model. Many of these theories in conjunction with previous studies allow us to make predictions of what to expect in terms of the produced coefficients.

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### Table 2: Variable Overview

<table>
<thead>
<tr>
<th>Sign</th>
<th>Variable representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y$</td>
<td>GDP/Capita</td>
</tr>
<tr>
<td>$X_2$</td>
<td>Non-Military Non-Educational Government expenditure</td>
</tr>
<tr>
<td>$X_3$</td>
<td>Education</td>
</tr>
<tr>
<td>$X_4$</td>
<td>Fertility</td>
</tr>
<tr>
<td>$X_5$</td>
<td>Gross Capital Formation</td>
</tr>
<tr>
<td>$X_6$</td>
<td>Military Expenditure</td>
</tr>
<tr>
<td>$X_7$</td>
<td>Interaction Variable 1990s</td>
</tr>
<tr>
<td>$X_8$</td>
<td>Interaction Variable 2000s</td>
</tr>
<tr>
<td>$X_9$</td>
<td>EU Indicator</td>
</tr>
<tr>
<td>$y$</td>
<td>Growth over the following five Year Period</td>
</tr>
</tbody>
</table>
The variables and their final definition and the data from which they are derived is stated in table 2 further down.

**Gross Domestic Product (GDP) per Capita**

The basic idea for GDP/capita is that the initial level of GDP serves as a proxy for the capital to labour ratio. The greater the ratio is the the further the economy is from a steady state. Meaning the easier and more potential there is for growth. Hence one would expect a negative coefficient for this sort of variable (Barro, 1997, p.1).

**Government expenditure**

The principle at play here is that government expenditures fundamentally can’t increase private productivity while only having short term limited effects on aggregate demand. While at the same time taxation has distorting effects on the economy in general, while simultaneously impacting private investment and saving negatively. Thus we can expect a negative coefficient for this sort of variable as well (Rebelo, 1990, p.9).

**Gross Capital Formation**

In the Barro model investment is equal to savings, in which savings will indicate an increase in the steady state of output of the economy. Therefore increased Capital Formation will indicate a raise in the steady state of output (Delong and summers, 1991).

Another way of viewing this is that the idea behind the variable of Gross Capital Formation is that capital invested in increasing productivity will with time in fact do so. Thereby meeting the very definition of growth.

**Education**

Education (in this case formal education) serves as a proxy for human capital. Human capital is of course a vital aspect in order for a labour force to allow for any sort of production. By definition, the more human capital an individual laborer of a work force has, the more capable it will be. Which is why such an aspect has been included in this model. Ultimately, we can thereby expect a positive coefficient for this variable (Barro, 1997).
**Fertility**

The idea of using fertility as a determining variable has multiple foundations. One motive being related to the same theory which motivated including GDP. Whereas said variable concerned the capital side of the aforementioned ratio, this variable accounts for the change in population which can be considered a proxy of sorts for the total work force.

Other research has shown that increases in education and human capital is linked with lower fertility among women, as educating oneself increasingly takes time, which cuts into the fertile time period of a woman’s life (Becker and Barro, 1988). For these two reasons together we can expect a negative coefficient for this type of variable.

**Interaction Variables**

The interaction variables are in place here to capture the the shifts and reorganizations which the sample countries were forced to undertake following the fall of the Soviet Union in the early 90s and 9/11. Since it’s difficult to put your finger on the precise day/moment in which the Soviet Union fell and more so, define exactly which step was the one critical in causing the nations in this study to rethink their defense strategy, I am choosing to use the turn of the century as a “proxy date” for denoting this shift. For the same reason I will use the turn of the millennium as a proxy for the shift towards “the war against terror” following 9/11.

Since the theories I have based these variables on are not “economic” per se, but relate more to the organizational aspects of military expenditure, I will not make any prediction of the coefficient other than I would expect that these shifts in fact do matter and that these coefficients will be significant.

**EU**

This is a by barro motivated dummy variable denoting whether or not a country is a member of (what is today) the European Union (EU). The main motive being that one would expect to see a convergence in growth and economic activity within a trade zone with time. Such a convergence would implicitly affect growth as well. As this sort of convergence could have both positive and
negative effects on the economy depending on the the individual (nation) observed I will not make any prediction here either, rather say that I expect this variable to be significant as well.

Further this variable could indicate differences in geographical-regional characteristics (between Europe and North America) (Barro, 1997).

### Table 3: Variable descriptions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP/Capita - Growth (Growth)</td>
<td>$Growth = \left( \frac{GDP_{\text{capita}}^{(t+5)}}{GDP_{\text{capita}}^t} \right)$</td>
</tr>
<tr>
<td>GDP/Capita</td>
<td>The variable of Gross Domestic Product (GDP) per Capita is based on two data sets, the first on GDP values and the second is based on population data. The variable GDP is then divided by Population.</td>
</tr>
<tr>
<td>Education</td>
<td>The Variable Education comes from the World Bank’s data, who defines this variable as the total public expenditures spent on education as a percentage of the Gross Domestic Product. This variable is used as it is presented by the World Bank.</td>
</tr>
<tr>
<td>Fertility</td>
<td>The variable Fertility comes from the World Bank’s data defined for the number of children which an average woman would deliver by the end of her fertile life.</td>
</tr>
<tr>
<td>Gross Capital Formation (GCF)</td>
<td>Gross Capital Formation is based on a data set which is also gathered from the World Bank, where it is defined as net changes to both fixed assets of the economy and net changes to inventories and investments in private homes, expressed as a percentage-share of GDP. This variable draws from data with under the same title, which is then used as the variable Gross Capital Formation.</td>
</tr>
<tr>
<td>Military Expenditure</td>
<td>The variables for Military Expenditure is based off of a data set called “MileEx” gathered by the Stockholm Institute of Peace Research (SIPRI).</td>
</tr>
<tr>
<td>Interaction variable (1990s)</td>
<td>There are two interaction variables here. Both are multiples of two factors. The first being the variable “MilEx” and the second being a dummy variable denoting whether an observation took place either during the 1990s or during the 2000s respectively (thereby using the 1980s as a base line,) for each interaction variable respectively.</td>
</tr>
<tr>
<td>Interaction variable (2000s)</td>
<td>This variable is an interaction variable between a dummy indicating weather the observation took place during the 2000s, where 1 indicates the observation took place during the 2000s and 0 indicates the 80s and 90s</td>
</tr>
<tr>
<td>EU</td>
<td>The EU variable is an indicator variable, indicating whether or not the observation took place inside of what is now the European Union (formerly the European Community).</td>
</tr>
<tr>
<td>non-Military non-Educational Government Expenditure</td>
<td>The variable non-Military non-educational Government Expenditure is partially based on data “Government Expenditure” and partially by the data titled “MileEx” and partially based on the data titled Education. MilEx and education are then subtracted from “Government Expenditure” in order to prevent from including the same expenditure twice.</td>
</tr>
</tbody>
</table>

The table above denotes each variable by it's definition.
4.4 MODEL FITTING

Semi-logarithmized function

Initial regressions showed problems concerning residuals with heteroskedasticity related to some of the variables, namely Fertility, initial GDP/Capita and military expenditure. Therefore a new model specification was tested, where said variables were logarithmized in order to minimize this problem. After making this swap, heteroskedasticity was significantly decreased when checking the residuals. This ultimately became the main function form used, thus turning the model into a semi-logarithmized function.

Heteroskedasticity

However, after a, for panel-data modified Wald test was run and yielded positive results still for heteroskedasticity I decided to use to use a specific type of regression which was robust for heteroskedastic residuals. This test is a type of regression is called the Huber/white or Sandwich Estimator. Through this I now had a regression which is robust for heteroskedasticity.

Overly Influential Outliers

With these new variables it became apparent that there were two groups of observations which constituted outliers. A closer look revealed that indeed these observations were substantially influential. The data showed that these residuals could be attributed to solely two specific countries, namely Slovenia and Bulgaria. So because these individuals were overly influential, the decision was made to drop them. By doing so the R-squared value rose.

Multicollinearity

When further reviewing data it became apparent that since this is “macro-data” there were a number of challenges in regards to the balancing of the data. Meaning even though the data was balanced to a degree, the gaps were significant enough to cause problems when running tests. Ultimately many of the preferred tests were not possible because of delimitations in software configurations. This meant that I had to improvise on some tests and do them manually. This
became clearest when testing for multicollinearity. Since the automated VIF tests wouldn’t work, I decided to do one manually. This meant trying to predict the variation of the independent variables with one or more of the other independent variables. After attempting this I was able to conclude that I could not to a significant degree explain any of the independent variables. This conclusion in combination with the fact that no two variables produced any high factor in a correlation matrix and that there is no reasons to suspect multicorrelation of the given variables from a theoretical standpoint led me to reject multicollinearity as a problem.

**Fixed effects**

At this point a decision had to be made of weather to run a fixed effects model or a random effects model.

A Hausman test was run in order to be definitively certain of which way to go. The results of which in fact indicated that a fixed-effects regression indeed was the more appropriate.

The operating assumption of using a fixed-effects model is primarily that when comparing individuals (in for example a panel-data regression model), there can potentially be a number of hidden factors which can not be observed or quantified, but which effect could be significant and may differ between individuals (nations in our case), we call this the unobserved heterogeneity. By this we mean characteristics which are time-invariant and specific to the individual. When using fixed effects we recognize that each individual has said unobservable or unquantifiable characteristics which can influence the individual errors of the model, this can also be called the unobserved heterogeneity. In order to account for this heterogeneity we ad an individual specific constant term to the equation, which signifies the individuals average for a given variable over time (thereby the time invariant characteristics). This average could also be thought of as a sort of individual specific intercept since it’s constant, we are thereby recognizing that (or allowing for) each individual to have their own intercept. This term is later subtracted from the equation, which is why one can not observe it directly in the final equation, thus eliminating the time invariant effects. When we do this we effectively merge the intercepts of the different individuals. When this is done what is left in the model are the time-variant effects, with a clearer picture of the effect of the specific variables we hope to study.
What this breaks down to in practicality is that we have controlled for unobserved heterogeneity (since that is largely what the individual specific constant term attempts to capture) while retaining the over time-variant aspects of the model and data. None of this would have been possible in a traditional linear model without fixed effects. You could say that with fixed effects you have controlled for all of the “stable” characteristics of an individual.

In doing this we have been able to exclude much of the between individual variation, in that when sampling you will likely find variation both between and within individuals. The problem here is that the between individual variation could be due to omitted variables, and therefore give biased errors (this is the problem with the aforementioned unobserved heterogeneity). Hence if we can recognize these characteristics we can account for them (we subtract them from). By doing so we can better exploit the data then we otherwise would be able to.

There is however a drawback, when merging the individuals intercepts the model generates significantly larger errors, so one may ask themselves what the point is? The reason for doing this is because the between individual variation may be contaminated with biased unobserved heterogeneity, which would effect the chances of observing the effects of the variables we are trying to observe. Because we are in this study looking to see causality this is important, more important than the model’s total predictive value. So by limiting ourselves within individual variation we are in effect eliminating the between individual variation which is in effect eliminating a potential source of contamination. In essence what we’re doing is sacrificing total predictive value for more unbiased estimates, in a way which would have otherwise not have been possible for with a traditional linear regression model without fixed effects.

**Residuals**

Further review of residuals and tests of the final model indicate that the model retained a degree of serial correlation, which poses a potential problem. From a technical standpoint this could mean that there is an omitted time related variable. However simply adding such a variable would have been ambiguous as it would lack a theoretical motivation from Barro’s behalf, posing a significant hindrance in itself. Furthermore for each added time related variable I chose to add, the the risk for an identity problem within the model increases, making the model more
and more tautological. As imposing an obvious barometer of growth as an independent variable would largely defeat the purpose of the whole model (I.E. predicting growth) I therefore choosing to accept a degree of serial correlation. Thus strictly delimiting my model to what could be motivated by Barro.

The residuals of the final model are presented in the appendix (see exhibit 10).

5 DATA
A collection of charts and graphs along with a more detailed summarization of the data set including means and standard deviations for all variables can be found in the appendix (see appendix, table 10), as well as charts of the development of military expenditure and growth over time by country (see appendix, exhibits 6 and 7).

5.1 DATA DESCRIPTION
In total we have observed 26 nations in this study, with observations spanning from the year 1980 up until 2013. There is however one challenge with the data. When viewing the data it quickly becomes obvious that the Nations seem to naturally for into two categories, namely “classically” Nato countries and “newcomers”. The classical Nato countries are the ones who were members prior to the fall of the Soviet Union and the newcomers are countries formerly associated with the Warsaw Pact. These countries are geographically divided along the former borders of the Iron Curtain. These “newcomer” nations can be further divided into two categories. The first being “older” nations which existed prior to the fall of the Soviet Union and the second being “new born” nations which didn’t exist priorly. These “new born - newcomer" nations present a challenge in that they lack data observations prior to the beginning of 1990s (give or take a few years depending on how long it took them to get it together). These countries include Croatia, Slovenia (formerly Yugoslavia) Czech Republic, Slovak Republic (formerly Czechoslovakia) Estonia, Lithuania, Latvia (formerly Russian territory)(Agency, 2013.).

5.2 SPECIAL CASES
Iceland is an exception as the nation lacks standing armed forces and has thus been excluded from the study.

Another special case is Germany, which is a case in which two countries were assimilated together (formerly the GDR and the FRG). Since however both countries have well-documented administrations historically, observations can be calculated retrospectively. Thanks to this fact, we can treat Germany as any other individual in this study.

6 RESULTS AND ANALYSIS

The table below denotes each variable's produced coefficient by the finalized model and the respective p-value as well as the model's total R-squared value.

<table>
<thead>
<tr>
<th>Variable representation</th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lg)GDP/Capita</td>
<td>−0.5375977</td>
<td>0.001</td>
</tr>
<tr>
<td>Non-Military Non-Educational Government expenditure</td>
<td>−0.0326752</td>
<td>0.092</td>
</tr>
<tr>
<td>Education</td>
<td>−0.0570291</td>
<td>0.209</td>
</tr>
<tr>
<td>(Lg)Fertility</td>
<td>−1.140763</td>
<td>0</td>
</tr>
<tr>
<td>Gross Capital Formation</td>
<td>−0.0194157</td>
<td>0.088</td>
</tr>
<tr>
<td>(Lg)Military Expenditure</td>
<td>0.1268122</td>
<td>0.593</td>
</tr>
<tr>
<td>Interaction Variable 1990s</td>
<td>0.7870977</td>
<td>0.633</td>
</tr>
<tr>
<td>Interaction Variable 2000s</td>
<td>27.02557</td>
<td>0</td>
</tr>
<tr>
<td>EU Indicator</td>
<td>−0.266032</td>
<td>0.088</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.3884</td>
<td></td>
</tr>
</tbody>
</table>

The final model produces an overall R-squared value of 0.3884. Which is high given the time restrictions of this study. This is on par with what Barro himself produced, who uses close to twice the number of variables. This is an encouraging result, as it shows that the model in fact has some value in its ability to predict and explain a significant degree of variation among the observations. Meaning that there is a significant degree of truth to the model as it provides a reasonably accurate prediction, and/or describe what is happening in the countries.
6.1 BARRO VARIABLES

**Gross Capital Formation**

The regression results indicate by and large what one could expect of a Barro model. With the exception of Gross Capital Formation which produced a negative coefficient, all of the Barro based variables produced the expected direction of coefficients. This raises questions concerning the model in general, because this is inconsistent with what the theory (stated in section 4.3.2) would lead one to think, as well as being contradictory to previous studies.

What we can say at this point is that Gross Capital Formation seems to be associated with degrowth for these observations. Because these results are so strange and still significant it begs the question, in what case would investment be associated with degrowth?

A scenario that could meet such criteria, could be that of government stimulus. When economies face recession many governments try to counter this by launching large stimulus programs. Whether they are successful or not is a debate in itself, but the fact remains that this phenomenon does occur. If this is in fact the reason for these observations, then it is somewhat surprising that government stimulus is so massive that it becomes the dominating effect. This is however just one of any number of possible explanations.

Barro presents us with another possible explanation. A negative association with investment (or Gross Capital Formation) could be due to an increase in investment opportunity (which is dependent of growth) rather than growth being the effect of investment. Barro further states that this problem would be greater in an open economy, where an investor could choose to place their assets abroad rather than domestically. Implying that increased investment could be due to an increase in savings from a foreign country, possibly in a boom period while the observed (“domestic”) country could be facing a recession. An interesting aspect of this explanation is that it seems to rhyme with the saying “Buy low, sell high”, meaning that it makes common sense (Barro, 1997 p32).

**Education**
A surprising result is that the variable for education could not produce a coefficient significant on the 90% confidence level. This could be due to a number of reasons which although are surprising, are not incoherent with the Barro model in their entirety.

For this there could be two possible explanations. The first has to do with the formulation of the theory with which Barro motivates this specific variable. The theory states that as a work force’s human capital increases the productivity of the workforce increases by definition, thus driving growth. As this theory is applicable to all stages of development, the theory holds true in a range all the way from the neolithic revolution to today's modern developed economies (like the ones observed in this study). That said and with the expressed relevant range, what we have in this study is one very thin sliver of the theory’s relevant range. Meaning that the countries may not differ considerably among each other, in regards to education. Thus we have incorporated in this study only the “uppermost” echelon of economies relevant to this theory. In statistical terms what one would say is that the variation among countries is too small for the model fill the relevant range.

The other reason for not having significant results could be due to a measurement error. We are using “Public Education Expenditure” as a share of GDP as a proxy of Education within a country, which we equated with human capital. There are several steps here which may not work as expected. One of these could be the step between the amount of assets a country spends on education and the actual education which comes of it. An example could be a country experiencing education levels falling at an alarming rate. The executive branches of government may consider deploying increased assets towards education. In such a scenario increased “Public Education Expenditure” would be the effect of decreasing education rather than the cause of increased education. Thus undermining the assumptions of how the proxy would work.

In reality the true cause for this variable failing to produce a significant coefficient could be a combination of both of the reasons as they are not mutually exclusive.

6.2 MILITARY EXPENDITURE

The most important results yielded from this model are the results concerning Military Expenditure. The relevant variables here are the two interaction variables and the variable MilEx.
The variable MilEx and the interaction variable for the 1990s failed to produce significant coefficients (at the 90% confidence level), while the interaction variable for the post millennium observations, produced a significant coefficient.

The technical interpretation of this is that the model can not fit a regression line to the observations which has a slope differing significantly from zero, for the variables MilEx and the interaction variable for the 1990s. Hence, we can not observe any clear effects. Unlike the interaction variable for the post millennium observations which produced a clear positive effect on growth.

Although these results may look contradictory at first sight, upon closer inspection they can still carry insight. What is made clear by the interaction variables is that the nature of the model changes, during the first decade of the 2000s.

The greater trend of military expenditure as shown by the variable MilEx, indicate that we can not discern a clear trend over the total time period. With the majority of the observations being made before the year two thousand, these observations are primarily of the classical sort of military expenditures, prior to the War on Terrorism. But as the indicator variable for the post millennial observations shows, something happens in the first decade of the 2000s, which changes the nature of the effect of military expenditure. It appears that the human capital effects combined with technological spillover effects, trump crowding out effects during the War on terrorism (as the coefficient is positive). This is indicative of an organization(s) shifting towards a more capital intense operation. Which is exactly what we would expect as a consequence of the 9/11 induced War on Terrorism.

This is what appears to have happened, but it would be callous of me to draw such bold conclusions from this model at this point. The stated explanations make logical sense and meet the criteria set by most (if not all) stated theories.

Still though there are certain weaknesses to the model which should not be overlooked. The main reason is that given our definition of growth, we will not have a complete set of observations for the first decade of the 2000s until January 1st 2016 (2010 + 5 = 2015). So we do not yet know what the consequences of the decisions made the remaining years will be (provided a five year time horizon).
There are other factors as well that require further investigation before they can be ruled out. For example, there may well have been some sort of shift in the nature of growth occurring at roughly the same time as the War on Terrorism, affecting growth in the observed nations. Additionally, the observations end (in 2008,) in the middle of a financial crisis (Baily and Douglas, 2009), which could possibly further affect the model. Ultimately, even though the the shift from cold war strategy, to the post cold war period (the 1990s), and the later post 9/11 shift to the War on Terrorism, have likely affected the nature of military expenditure towards a more capital intense type of operation, there are multiple possible explanations which I can not rule out solely with this model as a basis.

What I can say on the basis of this study is that there is no reason to believe that these potential explanations would be mutually exclusive.

If a later study were to show that these other effects (those not pertaining to military expenditure) could explain the variation in growth in a manner which could dwarf the significance of military expenditures significance, then perhaps we would want to reconsider the effect that military expenditures has on growth.

This study indicates that military expenditures possibly could have an affect on growth following the turn of the millennium. Weather this is the case and if so to what extent would be presumptuous to say at this point since there are a number of other effects which can not be ruled out.

At this point it simply seems possible that a more capital intense military strategy, possibly could have a positive effect on growth.

7 CONCLUSION

Although there is reason to suspect a change in the nature of the effect of military expenditure, following the turn of the millennium, the trend can not be conclusively proven as it is as of now too early a point in time to obtain a complete set of observations for the time period. This in combination with Military Expenditure's failure to produce any clearly discernible effect on growth in the previous time periods leads me to the conclusion that
We can not observe a connection between military expenditure and growth over the following five year period on the 90% confidence level.

Thus, we can not reject the null hypothesis.

However, we have reason to suspect that the later years shift in military strategy due to the War on Terrorism, has caused the positive (defined) channels of effect of military expenditure to weigh heavier than in previous periods. I want to stress that this is not solid conclusion, but rather that there is merit for a suspicion, warranting further investigation.

In relation to the opening quote (section 1) this means that is that these sort of claims are scientifically unsupported. That is, a claim arguing allocating assets to military expenditure as a means of achieving growth, in the context of (national) government budget allocation (among Nato countries), lacks a scientific foundation. Likewise arguing mitigated projected and/or incurred costs of military expenditure by promise of growth, also lacks scientific backing.

8 DISCUSSION

In this study I have applied the Barro based growth model to the field of defense economics in order to investigate how military expenditures can affect the growth of an economy. The ultimate results of this study show that for this given sample of countries and given a five year time horizon, we can not discern any clear consequence from military expenditures. The practical implication of this is that law and policy makers should not view military expenditures as an economic investment for social gain. But rather an investment solely in security. The case can still be made that security is in itself a source for growth, however in this study I have not investigated the connection between military expenditure and actual security. Thus the fact remains that we can not observe any relationship between military expenditure and economic growth.

Among the challenges which I encountered was that of obtaining sound data. This specific data set had the gaps in it's observations. This was a weakness for the younger countries as the total number of observations could in some cases become small. So for a later study I would suggest
redefining the population of nations to conduct the study on, in order to avoid this problem. This could be done by either studying some other sort of homogenous group of countries or by extending the time period for the study and either dropping the East Bloc nations altogether or account for their difference when modeling. A further time related matter which I believe ought to be investigated is time horizon for growth, which I believe could be augmented in later studies. Such an augmentation could possibly influence the results in a number of ways, as the defined channels of influence from military expenditure, do not necessarily come into effect simultaneously. Thus a ten year time horizon could potentially be enough time allow one of the postulated channels of effect to become dominant.

When it comes however to the Barro model there are also a few points which I believe would benefit from further clarification. The great strength of the Barro model lies in it’s flexibility, in that the supporting theories can be applied to just about any macroeconomic case. Hence the variables typically included are in practicality often proxies, an example of this are the theories concerning human capital and the (in this study) the proxy variable Education. In this study this variable simply doesn’t behave as expected from a Barro typed model, yet still Education is widely accepted as being a closely linked to human capital. Barro does himself reflects at a number of occasions over how his results can vary depending on how the variables are defined, concluding that the best ways were the ones which gave clearest results but ultimately a judgment call has to be made in each case. In this study the point was to test whether a specific variable could offer any explanatory value to the model. Meaning that an unclear effect, is a result in itself. However where to draw the line exactly and how much effort one should put into tailoring a model before concluding a result is not clear.

Another matter for later studies is that of growth following the turn of the century. Naturally there is not much work here due to the fact that there has not been a long enough time lapse to base any statistically robust study on. However now (January 2015) after 15 years we are beginning to approach a point where a picture can start to emerge. Because the model in this study showed such a drastic shift in the nature of effects after the turn of the century I believe it raises a valid question of whether the Barro model ought to be augmented, or if all of the supporting theories still apply in the same manner. Perhaps a “revised 21st century Barro model”
is needed? Hence even though it still might be a too early to determine whether or not the nature of growth has changed in the 21st century, the fact remains that the question will need to be addressed eventually.

As for the F-35 multirole 5th generation stealth fighter, I can share with you that as of new years 2015 reports have surfaced that the F-35 the multirole 5th generation stealth fighter, has due to unforeseen design flaws, been further delayed another four years and won’t be fully operational until some point in 2019 (at an unknown additional cost to taxpayers) (Majumdar, 2015).

9 APPENDIX

Table 4: Data Definitions and Sources

<table>
<thead>
<tr>
<th>Data</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>Gap-minder has compiled the data from several sources, such as official international statistics, various historical sources and our own estimates.</td>
<td>Gapminder (2014)</td>
</tr>
<tr>
<td>GDP/Capita</td>
<td>The variable &quot;GDP&quot; Divided by the variable &quot;Population</td>
<td></td>
</tr>
<tr>
<td>LgGDPCapita</td>
<td>The natural logarithm of the variable &quot;GDP/Capita&quot;</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>General government final consumption expenditure includes all government current expenditures for purchases of goods and services (including compensation of employees). Expressed as a percentage-share GDP.</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>Expenditure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP/Capita5YearGrowth</td>
<td>The total percentage growth of the variable &quot;GDP&quot; over a five year period</td>
<td></td>
</tr>
<tr>
<td>Education (EduGDP)</td>
<td>Public expenditure on education expressed as a percentage of GDP in a given year. Including government spending on educational institutions (both public and private), education administration, and transfers/subsidies for private entities.</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>Fertility</td>
<td>Fertility is defined by the World Bank as the number of children that would be born to the average woman if she were to live to the end of her childbearing life.</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>LgFertility</td>
<td>The natural logarithm of the variable &quot;Fertility&quot;</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>Definition</td>
<td>Source</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Education (EduGDP)</td>
<td>Public expenditure on education expressed as a percentage of GDP in a given year. Including government spending on educational institutions (both public and private), education administration, and transfers/subsidies for private entities.</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>EU</td>
<td>A dummy variable indicating weather or not a country is a member of the European Union (or formerly the European community)</td>
<td>European Union (2014)</td>
</tr>
<tr>
<td>Education (EduGDP)</td>
<td>Public expenditure on education expressed as a percentage of GDP in a given year. Including government spending on educational institutions (both public and private), education administration, and transfers/subsidies for private entities.</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>Military Expenditures (MilEx)</td>
<td>The Data for Military Expenditure were retrieved from and gathered by the Stockholm Institute of Peace Research (SIPRI). These values are then expressed as percentage shares of GDP from which then the natural logarithm is generated. SIPRI defines military expenditure as “The SIPRI definition of military expenditure aims to include all spending on current military forces and activities” This measure includes (but is not exclusive to) - Armed forces, including peacekeeping forces - defense ministry(s) - paramilitary force(s) - procurement/research and development; - civil defense - veterans’ benefits - mobilization and demobilization</td>
<td>Sipri (2014)</td>
</tr>
<tr>
<td>LgMilEx</td>
<td>The natural logarithm of the variable “MilEx”</td>
<td></td>
</tr>
<tr>
<td>non-Military non-educational Government Expenditure (nonMilEduGovEx GDP)</td>
<td>The variables &quot;MilEx&quot; and EduGDP” subtracted from the variable &quot;Government Expenditure&quot;</td>
<td></td>
</tr>
<tr>
<td>Education (EduGDP)</td>
<td>Public expenditure on education expressed as a percentage of GDP in a given year. Including government spending on educational institutions (both public and private), education administration, and transfers/subsidies for private entities.</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>Gross Capital Formation</td>
<td>Gross capital formation consists of additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements, fences, ditches, drains, machinery, and equipment purchases, the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and “work in progress.” According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Which is expressed as a share pf GDP</td>
<td>World Bank (2014)</td>
</tr>
<tr>
<td>1990s dummy variable</td>
<td>A dummy variable denoting weather or not an observation took place during the 1990s or not. Where 1 indicates that an observation from the 90s and 0 indicates the 80s and 2000s</td>
<td></td>
</tr>
<tr>
<td>2000s dummy variable</td>
<td>A dummy variable denoting weather or not an observation took place during the 2000s or not. Where 1 indicates that an observation from the 2000s and 0 indicates the 90s and 90s</td>
<td></td>
</tr>
</tbody>
</table>

Above is a table detailing the different data sets which were together used to generate the variables used in the model created in this study.
Table 5: Country panel-number

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Albania</td>
</tr>
<tr>
<td>2</td>
<td>Belgium</td>
</tr>
<tr>
<td>3</td>
<td>Bulgaria</td>
</tr>
<tr>
<td>4</td>
<td>Canada</td>
</tr>
<tr>
<td>5</td>
<td>Croatia</td>
</tr>
<tr>
<td>6</td>
<td>Czechoslovakia</td>
</tr>
<tr>
<td>7</td>
<td>Denmark</td>
</tr>
<tr>
<td>8</td>
<td>Estonia</td>
</tr>
<tr>
<td>9</td>
<td>France</td>
</tr>
<tr>
<td>10</td>
<td>Germany</td>
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<tr>
<td>27</td>
<td>United States</td>
</tr>
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</table>

This table (left) is the assigned panel-number for each country used in this study.
Above is a collection of graphs showing the development of Military Expenditure as a share of GDP over the complete time set of this study, where each graph represents a given individual (Nation) denoted by their respite panel-numbers.

Above is a collection of graphs showing the growth development of over the complete time set of this study, where each graph represents a given individual (Nation) denoted by their respite panel-numbers.
Above is a scatter plot of the residuals produced by the regression model used in this study, scatter against time.

Table 9

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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</table>

Above is a chart detailing the number of observations, mean, standard deviation minimum and maximum for each variable respectively.
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