DEFENSE SPENDING AND ECONOMIC GROWTH: A LOOK INTO THE FORMER MEMBERS OF THE IRON CURTAIN

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ABSTRACT

The effects of military expenditures on an economy are characterized by a lack of agreement amongst economists. Classical economists, or free-market thinkers, contend that spending on defense diverts resources from more efficient purposes. On the other hand, Keynesians or those of the Structurialist school, argue that defense spending can improve economic growth through the improvement and construction of important infrastructures.

Research prior to the 1990's was identified through a non-econometric approach which we will denote as the First Generation. Economists would analyze the issue from a theoretical standpoint. This provided the foundation for research from the 1990's onward, as econometric tools became more sophisticated. In recent years, economists have been able to test the legitimacy of the theories put forth in the first generation.

Despite the use of various models, including least-squares regressions, endogenous growth, growth curves, economists still lack a general consensus. Furthermore, many models suggest that there is no relationship between economic growth and military expenditures at all. This paper explores ideas from both a theoretical and econometric point of view, standpoints of which includes a positive, negative, or no relationship, between military expenditures and economic growth.

From our analysis, we argue that the best approach involves a country by country analysis as opposed to a generalized view. Each country has its own characteristics that can influence the relationship between defense spending, or any other factors, and economic growth.

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CHAPTER 1

INTRODUCTION:

In this report, we focus on the relationship between the defense burden and GDP growth. To identify this relationship, we have outlined the steps as follows. We begin by dividing a literature review into two generations. Second, we consider this relationship using a unique dataset for the former Soviet States in Eastern Europe. While economic growth remains a popular research topic, the effects of military spending on growth has been largely ignored.

The primary concern when considering the relationship between the defense burden and growth is that the prior belief of this particular relationship is unclear. There are two major schools of thought that we will discuss later in the paper, namely, the "Structuralist School", led by Emile Benoit, and the "Free Market Thinkers", led by Robert Barro. The Structuralists contend that military expenditures may be beneficial to economic growth, particularly in terms of increased employment opportunities. The Free Market Thinkers contend that the diversion of funds to military expansion would thereby reduce economic growth by preventing the funds from going to more productive uses. Alas, some economists will claim that there is no significant relationship at all.

Other economists will argue that the relationship between military expenditures and growth depends on the level of economic development, and that some economies, perhaps developed economies like the United States, are more likely to realize positive benefits from higher military expenditures, due to research and development. Some Structuralists, namely Emile Benoit, who we will discuss in detail later on, will assert that developing economies

benefit most from a high military presence due to their building of infrastructure. These are all topics that will be discussed in later chapters.

For the empirical section of this report, we examine that case of the former Soviet republics in eastern Europe. We believe that this is an important example since these economies are recognized as transitional economies, that is, economies that are undergoing a change from a centrally planned economy to a market economy.

The implications of such a study are not just beneficial for the countries of interest. As the U.S. enters another election year, the defense burden tends to remain a point of debate, as politicians on both sides of party lines encourage the increase or decrease of military spending. Military topics are also worth discussing as major figures such as Bill Gates are citing a serious imbalance of the source of NATO support, with the US being the main contributor[1]. With no definitive answer as to what may happen as a result, it is important to continue studying the defense-growth relationship, particularly as the growing threat of terrorism rises.

The next section recognizes the first generation of research on the effects of military spending and economic growth. These papers are marked largely by a non-econometric approach. Starting with a brief overview of the literature prior to 1970, we will discuss three major contributors, namely: Emile Benoit, Daniel Landau, and Robert Barro. The next chapter will emphasize newer approaches by Xavier Sala-i-Martin, Casey Borch and Michael Wallace, and Giorgio d'Agostino. Our final focus will be based on exploring both groups of researchers which helps clarify our own empirical results.

[1] This is especially important as US tanks are rolling into Germany (who could easily provide tanks and other armored vehicles and artillery) and other Eastern European countries as of June of 2015 in attempt to diffuse the Ukrainian Crimea Crisis. This was reported from a June 2015 CNN article.

LITERATURE REVIEW: CHAPTER 2: THE FIRST GENERATION

BEFORE 1970

Prior to the 1970's, the main focus of macroeconomists was searching for the general answer on what spurs economic growth. Robert Solow proposed his own growth model using neoclassical theory, from which Kuznets was influenced. However, defense or military spending was not a typical parameter in their models. In one of Kuznets' most well-known works, *Modern Economic Growth* (1966), he proposes the following: "Political instability and nonrepresentativeness of the regimes, combined with an authoritarian structure dominated by personalist leaders and backed by familial and ethnic ties and the police, are hardly favorable conditions for economic growth… (Kuznets, pg 483)."

Kuznets took a cautious approach to his interpretation of the relationship of the political economy by analyzing general correlations amongst GDP growth and various metrics for political freedom for various developing countries. Kuznets' remarks "the absence of a cogent and quantitatively testable theory of interrelations between political structure and modern economic growth is no ground for dismissing {sic} more obvious implications from the dataset (Kuznets, 452)." Kuznets's work in economic growth was considered a pinnacle work in its time, leading Kuznets to earn the Nobel Peace Prize in Economics for his work in economic growth.

While defense spending and its effects were not widely researched at this time, Kuznets' general comments on growth were widely popular during the 1950's and 1960's.

THE FIRST GENERATION:1970s-CHAPTER 2-1

As the Cold War and arms race between the United States and the Soviet Union waned on, defense spending and economic growth started to become a prominent research topic. In 1973, Emile Benoit published a pinnacle work in defense economics titled *Defense and Economic Growth in Developing Countries".* Benoit was amongst the first to specifically address defense spending in growth models. The premise of his work was based on "the relation between defense programs and the rate of economic growth between 1950 and 1965 in 44 developing countries accounting in 1965 for around 80% of defense expenditure in the developing world, exclusive of mainland China (Benoit, pg 1). The approach that Benoit took was similar to Kuznets in the sense that he observed trends amongst these countries without employing more sophisticated econometric tools. Through Benoit's work, he observed that "the simple correlation between defense burdens and growth rates was strongly positive: countries with high growth rates tended to have high defense burdens, and vice versa (2, Benoit)". However, Benoit's analysis led his research to become criticized, later on. In spite of this, his work was instrumental for identifying avenues of research for the newer generation.

When discussing military expenditures and economic growth, the first argument that appears is what is described by Benoit as "Investment Effects" and then broken down further into "Productivity Effects" and "Income Shifts Effects". He formally defines Investment Effects as "the diversion into defense uses of resources that would otherwise have gone into investment (Benoit, 8)." Investment Effects are commonplace in other facets of economics, whereas Productivity Effects and Income Shifts Effects are specifically outlined by Benoit. "Productivity Effects are related to the general lack of measurable productivity growth in the government and

defense sector (Benoit, pg 11)". Furthermore, as resources are diverted to military or government purchases, they are not being used in a productive manner. Income Effects are more specific and related directly to the "implied reduction in the size of the civilian product when a part of GDP is shifted or reallocated to the defense sector (Benoit, pg 14)." Whether the latter two are actual GDP effects is up to interpretation by Benoit. This can be dangerous in the sense that there is no true way to measure the Productivity and Income Shift Effects. Because Benoit's book focuses on developing countries, he makes no mention of possible externalities, such as research and development, as a result of increased military expenditure.

Benoit's data is pulled from two different time periods (1950-1965 and 1960-1965) which he calls the A series and C series respectively. "The 44 countries were not scientifically selected, rather they were chosen on the basis of including as many countries as possible for which constant price estimates could be obtained both of national product and of defense expenditures" (Benoit, pg 37). This process thereby excludes some countries that may be interesting from a research standpoint. Some countries are of our particular interest, including the now defunct Yugoslavia. Benoit was skeptical of taking data from his countries of interest, so he instead used the estimates from the UN, IMF, AID, and IBRD sources, with the exception of 12 countries, which will be discussed later.

To conduct his analysis, Benoit used the following metrics: "growth rate of GDP (called G), civilian GDP, found by subtracting defense expenditures from GDP (denoted by G'), the defense burden (B), which he defines as a ratio of defense expenditures to GDP both at current prices and local currency, investment (I), and external resources (R)[2] (Benoit, pg 69). Benoit

[2] External Resources mainly encompasses bilateral aid.

used Spearman's Rank Order Correlation to get a basic idea of the data. It was in this investigation where Benoit noted positive correlations between the defense burden, B, and GDP growth, G. Benoit "tested his results in three ways: First by excluding from the sample twelve countries for which the comparability of the data might be questioned (Costa Rica, Dominican Republic, El Salvador, Ghana, Kenya, Jordan, Syria, Tanzania, Uganda, South Vietnam, and Zambia); second by examining the correlation for the years 1960-1965 alone, for which the data are undoubtedly more reliable and consistent; and third, by adding nine other countries (Algeria, Bolivia, Cambodia, Cyprus, Ethiopia, Jamaica, Nicaragua, Paraguay, and Uruguay) to the 44 country sample (Benoit, pg 70)". The removal of the 12 countries was due to the level of trustworthiness of the data, as Benoit was unable to get reliable estimates from a multilateral institution such as the IMF or World Bank. For the first exercise, of the 32 countries Benoit's "analysis showed a positive simple correlation between B and G of 0.51 with a t-value of 3.2 (Benoit, 70). The third exercise which included nine other countries had a correlation of determination, (which is used to determine the strength and direction of a relationship), r=0.31, and t-value of 2.4, which is significant at the 5% level, albeit significantly weaker than the comparable data set was used (Benoit, pg 71).

Benoit employs simple linear regression to continue his investigation between B and G and maintains that the two metrics are positively correlated. He conducts several hypothesis tests to detect spuriousness and significance of his coefficients[3], all of which support his final conclusion in which high defense burdens are conducive to higher rates of economic growth.

[3] As described in the previous page.

This is the extent of which Benoit used statistical procedures. Furthermore, the vagueness and incomplete nature of his analysis led him to be susceptible to disapproval.

Through Benoit's study, defense burdens and GDP growth became a more compelling research topic. Unfortunately for Benoit, many of his methods were criticized, beginning with the dataset. Due to the potential unreliability of some of the countries' data and general lack of fit with other observations, Benoit removed observations, for which he was severely disparaged. While sophisticated empirical studies were rarely done in the 1970s, the general nature of Benoit's "econometric" study was marked as too simplistic. A Spearman Correlation (mostly Pearson Correlations, now), are generally not accepted as a reason to make conclusions about correlations.

The chief concern regarding Benoit's work is his regression model. While he claims to test the "spuriousness", it is difficult to make suppositions of such a model due to the lack of parameters, particularly more control variables, in the model. In fairness, this could be due to the lack of computing ability in the early 1970's, however, the model should include more than the metrics listed in a previous section. General consensus amongst economists supports that there are many influencing factors in GDP growth, including defense burdens, but also parameters like educational attainment and access to healthcare. Economic growth tends to be a mystified research question and there are no accepted parameters that must be included. Despite these shortcomings, Benoit is considered a paramount work in defense economics due to the shocking level of his findings. Benoit's conclusions are unique in the sense that very few economists have found such positive correlations. At best, many economists find inconclusive results. Alas, the irreproducibility of Benoit's study has made it a compelling debate.

1980's- CHAPTER 2-2

The 1980's ushered in further research on defense spending and economic growth, led primarily by Daniel Landau. At this time, many of Benoit's practices in his 1973 work have already been deemed obsolete. Landau's 1983 paper, "Government Expenditures and Economic Growth: A Cross Sectional Study" was paradigm to Robert Barro's future work, which we will discuss in a further section. Landau's initial paper was much more econometrically involved than Benoit's. Landau is able to utilize data from the World Bank involving 104 countries total "minus eight oil exporters or 96 non-communist countries." (Landau, pg 786). When conducting his analysis, Landau uses the sample of 96 countries, as he was unsure of the GDP effect of including countries that are major oil exporters. Using general economic growth models proposed by Kuznets, Landau was able to fit a comprehensive model, avoiding Benoit's oversimplification pitfall. Unlike Benoit, Landau's conclusion is what most economists would expect---that heavy defense burdens are associated with lower GDP growth.

Landau sets the foundation of his research by identifying two major economic schools of thought regarding defense burdens and economic growth, being the "free market thinkers" and the "Structuralists". Moreover, Landau illustrates how divisive the opinions are by stating "a believer in the free market would expect government expenditure to be less efficient than private even if it was in the field of human capital, and thus he would predict the higher the government spending (GS) the lower the growth of GDP (Y). The "Structuralist School" would contend that certain government expenditures have been and will be necessary to remove impediments to economic growth, and under certain circumstances, a higher GS would be associated with faster growth" (Landau, pg 784). The ideas proposed in Benoit's paper regarding Investment Effects parallels many of the Free Market schools' thoughts, however his findings in his 1973 are

contradictory to that. The speculation carefully described in Landau's work remains in more recent research publications on the topic.

The upcoming section is a description of Landau's model, for which we will utilize Landau's (1983) notation:

Overall Regressions[4]:

Time Period: 1961-1970

$\widehat{Growth}$=3.97-0.179(GS)-0.0019(Y) +0.0026(TIE) +1.04(Z13) +1.91(Z19)……. (1)

(1.69)** (0.87) ** (0.0004)* (0.004) (0.55) *** (0.56)*

Time Period: 1961-1972

$\widehat{Growth}$=3.77-0.178(GS)-0.0021(Y) +0.028(TIE) +1.08(Z13) +1.67(Z19)…… (2)

(1.44)*** (0.074) ** (0.00037) *** (0.0036) *** (0.47) ** (0.48) ***

Time Period 1961-1974

$\widehat{Growth}$=4.14-0.188(GS)-.002(Y) +0.027(TIE) +0.751(Z13) +1.23(Z19)……. (3)

(1.31)*** (0.067) *** (0.00033) *** (0.0033) *** (0.43)* (0.44) ***

Time Period 1961-1976

$\widehat{Growth}$=4.25-0.188(GS)-0.0021(Y) +0.026(TIE) +0.432(Z13) +0.604(Z19)……. (4)

(1.33)*** (0.067) *** (0.00034) *** (0.0034) *** (0.45) (0.46)

Regressions within Low-Income Countries:

Time Period 1961-1976

$\widehat{Growth}$=3.80+0.059(GS)-0.0039(Y) +0.024(TIE) +2.48(Z13) +2.10(Z19)…… (5)

(3.23) (0.091) (0.0021) *** (0.0057)* (1.37) *** (0.58)*

Time Period 1961-1976

$\widehat{Growth}$=4.45+0.032(GS)-0.0043(Y) +0.031(TIE) +3.31(Z13) +1.22(Z19)……. (6)

(3.42) (0.447) (0.0021) ** (0.005)* (1.31) ** (0.49) **

- GS represents Governement Spending
- Y represents GDP Growth
- TIE represents Total Investment in Education

[4]***= Significant at 0.1, **=Significant at 0.05, *=Significant at 0.01.
Standard Errors are listed underneath the estimates.

- Z13 is a dummy variable for countries in the Mediterranean Climate Zone
- Z19 is a dummy variable for countries in the Tropical Rain Forest Climate Zone

Of the four metrics used to stand in for human capital, Total Investment in Education (TIE) was the only variable that remained in the final regression model. Landau uses TIE as a variable representing investment in human capital, which is a popular parameter choice. This covariate later becomes a point of contention, since Landau chose to use a constant level of education spending, which would go against the "free market" ideology that as government spending increases, ceteris paribus, so would other investments, specifically public investment in education. To account for the agrarian nature of low income countries, Landau uses agricultural land per capita and a dummy variable that conditions for the climate zone, which greatly affects the arability of land. Furthermore, "Marxists and some other development economists contend that colonialism or "neo-colonialism" has had serious negative impacts on the growth of the low income countries (Landau, pg 786)." Of these measures Landau chose to represent the fertility of land, the only two surviving predictors in the final model[5] are Z13 and Z19 are Mediterranean and Tropical Rain Forest, respectively.

The results of the Landau model are quite intriguing, as based on (1), (2), and (3), a country located in a Mediterranean (Z13) climate zone, ceteris paribus, will see positive growth as a result of their region. Similarly, countries in a Tropical Rain Forest (Z19) climate, ceteris paribus, will also enjoy positive growth rates due to the degree of arability of the land. Most importantly, though, depending on whether or not a country is considered low-income or not will determine the effect of military expenditures on growth. Overall, as described in equations (1)-(5), GS is negative, and as increase in military expenditures increases, economic growth falls

[5] . Energy consumption per capita (EC) is used to illustrate the share of industry in GDP, as Landau cites that "the share of primary products in exports is a poor indicator of economic growth (Landau, 786)." Interestingly enough, EC was selected to stay in the model after the stepwise procedure, but due to its low statistical significance, Landau removed it from the model.

around 0.188%. In low-income countries, the effect is much smaller, around 0.05%, however, both are insignificant.

One of the most challenging aspects of modeling economic growth in general is the simultaneity issue----what causes economic growth and what is a result of economic growth and how can we differentiate between the two (Landau, pg 787)? This problem is mitigated by using a two-stages least squares model, which is illustrated in (1), (2), (3), (4), (5), and (6), however, Landau did not describe his use of instrumental variables or the process of his two-stages model.

From his regression, Landau was able to conclude that the negative correlation existed for all observations except lower income countries as shown in (5) and (6), however, it was statistically insignificant. The one issue in this observation is that he fails to provide a p-value or a real basis for why or how these coefficients are statistically insignificant. However, the level and ability to report econometric results has improved within the past 30 years, so Landau may have been a victim of the time. Regardless it is still a peculiar finding and Landau states "they are not a solid foundation for strong conclusions because; one, the government share variable is only government consumption expenditure, not either total government expenditure or total government economic impact; two, government expenditure might help increase economic welfare even if it decreases the growth of per capita GDP (Landau, 788)". This observation points out the free market standpoint, however, it does not dismiss the notion that government spending may be beneficial in other non-quantifiable ways.

This leads well into our analysis of our third major contributor, Robert Barro, whose main complaint with previous studies was the lack of exogenous parameters, like the change in

technology or population. He extends on some of the methodology proposed by Landau, however he uses the more modern and powerful endogenous growth model.

Early 1990s- CHAPTER 2-3

Robert Barro's major contribution came in 1990 with the publication of *Government Spending in a Simple Model of Endogenous Growth.* His model is greater in complexity than Landau's, but allowed for research development in the new generation, which we will discuss in the next chapter. The foundation of Barro's model is built on "constant returns to private capital, broadly defined to encompass human and nonhuman capital" (Barro, pg 104). While one could consider using increasing returns to represent potential positive externalities as a result of defense expenditure, primarily research and development, this complicates the long-run and steady state interpretation. Increasing returns to scale in the growth model may also be inappropriate, as the scope of Barro's paper is primarily in developing countries, where R&D is unlikely to arise due to higher levels of defense expenditures.

Using this constant returns to scale, Barro can succinctly identify the production function into Cobb-Douglas form, which in this case, maximizes the savings rate. However, a compelling piece of his model, in our particular case, is his outlining of "public services as acting input to private goods and services" (Barro, pg 106). Empirically, this could make the model more difficult computationally. To mitigate this, Barro points out "as long as the government and the private sector have the same production functions, the results would be the same if the government buys private inputs and does its own production, instead of purchasing only final output from the private sector (Barro, pg 106)." Consequently, with government spending in

general, we must be concerned about externalities and public goods, and whether or not one can truly label some public services as nonrival. Barro, amongst other economists in previous studies, contend that the public services are nonrival. Perhaps one of the more beneficial features of Barro's model is that it can be altered to accommodate for rival public service and is open for interpretation. The motivation behind using an endogenous growth model is based on the idea that some of the contribution to growth arises from exogenous factors, particularly technological advances, which maybe R&D in the military sector, in relation to our work. Barro was able to use his endogenous growth model for involving policy implications such as the "size of government and savings and growth rates", but he was also able to apply it to government spending and growth rates.

Barro's model deviates from Landau in one significant way, the defined level of investment in education. Landau ran his regression using constant investment in education to which Barro argues that "one channel for a negative effect of more government on growth involves a reduction in investment, the interpretation is different if a component of investment is held constant (Barro, pg 122)." To be more clear, Barro's chief concern with leaving investment in education constant in the model is related back to "investment effects"; if a government chooses to divert more funds to defense, other programs or campaigns, like education, will see a reduction in funds. A compelling argument put forth by Barro was that "the growth rate and defense expenditures depends largely on how governments behave, and whether or not they choose too little (or too much) productive public services, as opposed to optimizing, which would produce small cross-sectional correlation (Barro, pg 123)." The issue is the difficulty in predicting how a government may behave and how they should behave and how that may affect that country's economic growth.

It is through these questions asked by Barro that seems to solidify the "free market thinkers", as illustrated by Landau (1983). Barro falls into our "free market thinker" category through his skepticism of the "efficient allocation" of government resources and through the belief that an increase in government spending results in the crowding out of other, more productive investments. These topics and the use of dynamic models as proposed by Barro marks the beginning of a new approach for modeling the relationship between growth and defense expenditures. His successor and research partner, Xavier Sala-i-Martin, is later able to effectively identify and deal with some of the shortcomings acknowledged throughout the "first generation".

The approaches to studying growth evolved into more complex and econometrically involved models since the publication of Barro's (1991) influential work. This trend continues on to present day, even as we discover more about the implications of higher defense spending on growth and other aspects of economic measures. In this section, we consider more contemporaneous works done by Xavier Sala-i-Martin, Giorgio d'Agostino and Casey Borch and Michael Wallace. These authors represent the "new generation" of economists representing the relationship between growth and defense spending.

CHAPTER 3: THE NEW GENERATION

MID TO LATE 1990's- CHAPTER 3-1

We begin our analysis of modern growth models with Xavier Sala-i-Martin and his famous 1997 paper, "*I Just Ran Two Million Regressions*". With a catchy title, this paper is

actually founded on many of Robert Barro's papers, including the paper we discussed in the previous chapter.

To address this problem, Sala-i-Martin compiles 60 variables which have proved statistically significant in at least one regression (Sala-i-Martin, pg 178). On that note, a similar issue arises when one has included a set of predictors, but as more are added, some remain significant, while others do not, and as Sala-i-Martin says "what are the variables that are really correlated with growth (Sala-i-Martin, 178)?" This question was examined by Levine and Renelt (1985), and in this case, they employ a "robustness" test explained in Leamer (1985); This test determines how closely related or "robust" a chosen set of predictor variables are to the response variable. Levine and Renelt (1992) show that none of their predictors involving an economic growth model "passed" the robustness test. They are not the only ones who have utilized this statistical tool, and, in fact, some economists claim that there are no predictors for economic growth that are "robust".

However, Sala-i-Martin contends that "the test is too strong for any variable to pass it (Sala-i-Martin, 179)." Thus, Sala-i-Martin abandons this robustness test entirely, and relies on using confidence levels instead.

With a total of 62 variables located in previous literature as being statistically significant, the permeating issue of predictor specification arises. As noted by both Sala-i-Martin and some his predecessors, including Barro, the general consensus for growth modeling includes no less than seven predictors. Some covariates should be included in groups, and, as indicated, by Sala-i-Martin, if he were to choose 6 predictors out of the 61, allowing one variable to remain in each regression, he would be estimating 3.4 billion regressions in a total of 4 years (Sala-i-Martin, pg180)! Thus, Sala-i-Martin used the same regression approach as Levine and Renelt (1985),

however abandoning their model selection tools, and kept 3 covariates fixed in each regression, and chose 4 more from the remaining 59 variables, which turns out to be 30,856 regressions per covariate for a total of 2 million regressions, hence the title of his paper (Sala-i-Martin, pg 180).

The first significant question is, which three covariates should always be present in the model? Sala-i-Martin pulls upon prior literature to make his final decision, which includes the three following covariates: level of income, life expectancy, and primary-school enrollment rate, along with the dependent variable, growth, all from 1960 to minimize endogeneity. Below is the table that include only statistically significant predictors or predictors that Sala-i-Martin found close to normal.

Table 3-1: Sala-i-Martin Results (Dependent Variable = GDP Growth)

Independent Variable	(i) Coefficient (β)	(ii) Standard Deviation**
Equipment investment	0.2175**	0.0408
Number of years Open economy	0.01985**	0.0042
Fraction Confucian	0.0676**	0.0149
Rule of Law	0.0190**	0.0049
Fraction Muslim	0.0142**	0.0035
Political Rights	-0.0026**	0.0009
Latin America Dummy	-0.0115**	0.0029
Sub-Saharan Africa Dummy	-0.0118**	0.0045
Civil Liberties	-0.0029**	0.0010
Revolutions and coups	-0.0140**	0.0053
Fraction of GDP in mining	0.0353**	0.0138
SD black-market premium	-0.0290**	0.0118
Primary exports in 1970	-0.0140**	0.0053
Degree of Capitalism	0.0018**	0.0008
War dummy	-0.0056**	0.0023
Non-equipment investment	0.562**	0.0242
Absolute latitude	0.0002**	0.0001
Exchange-rate distortions	-0.0590**	0.0302
Fraction Protestant	-0.0129**	0.0053
Fraction Buddhist	0.0148**	0.0076
Fraction Catholic	-0.0089**	0.0034
Spanish colony	-0.0065**	0.0032

Note: ***= Significant at 0.1, ** = Significant at 0.05, *= Significant at 0.01

From **Table 3-1**, we see that government spending or defense expenditures are not included. Sala-i-Martin mentions that "they are not in the table because they appear to not be important: no measure of government spending (including investment) appears to affect growth in a significant way…" (Sala-i-Martin, pg 183). However, Sala-i-Martin leaves this disclaimer "in fairness to the authors who proposed these variables, I should say that they specifically say that they affect growth in non-linear ways, and my analysis allowed these variables to enter in a linear fashion only" (Sala-i-Martin, pg 183). At the same time, the War Dummy Variable is still significant, and has a value of -0.0056, meaning that all other things equal, growth will fall by 0.0056 if there is an ongoing war. It is also interesting to note that growth will fall by -0.0140 if the country is undergoing a revolution or coup. Granted, it is difficult to make a final assessment on the strength and magnitude of these results, as Sala-i-Martin makes no note of what the average GDP growth rate is for his selected countries. Because military expenditures are found to be statistically insignificant in this case, Sala-i-Martin falls into neither the Structuralist nor Free Market thinker category.

THE NEW MILLENNIUM: CHAPTER 3-2

The next section will focus on the 2010 paper *"The Defense-Growth Relationship: An Economic Investigation into Post-Soviet States"*, by Bruce McDonald and Robert Eger. McDonald and Eger's 2010 paper focuses on transitional economies, which encompasses a country that is undergoing the change from a centrally planned economy to a market economy. McDonald and Eger's paper has important implications as it emphasizes the need and use of lagging and fixed effects models. These topics will be discussed further on in this section. Many of these economies had high defense burdens, due to their location along the "Iron Curtain". McDonald and Eger even state that "much research on the Soviet Union has agreed

that such high levels of defense spending strained the economy and helped bring the country to an end sooner than it might have in other circumstances" (McDonald, Eger,pg 1). The relationship between military expenditures and growth in transitional economies is more blurred than those of developing or developed economies, as fewer studies have been conducted.

A predominant issue in the literature is the reliability of data, particularly for developing and transitional economies. Many transitional economies have questionable data due to the former regime's interest in keeping economic indicators inflated. McDonald and Eger's main source of data is from the Stockholm International Peace Research Institute (SIPRI)'s *World Armaments and Disarmaments Yearbook* (McDonald, Eger, pg 12). Some estimates proved unreliable, or were missing, and in those cases, McDonald and Eger called upon the World Bank to make up for the holes in the data. The only post-Soviet country to be completely excluded from the analysis is Turkmenistan, on the grounds of poor data availability.

Upon the basis of previous literature, McDonald and Eger opt to employ a non-linear least squares method and ultimately decide on a fixed effects model at the country level. One key feature of their analysis is the presence of lags, "as the impact of defense spending on economic growth tends to include a delayed effect (McDonald, Eger, pg 14). The lag in McDonald and Eger's 2010 paper is set to two years. The choice of lag is debatable, as it may take longer than two years to see any effects as a result of the military spending. However, given the shorter time span of the data, a two year lag is chosen (McDonald, Eger, pg 14). The fear in using lags, however, is the presence of serial correlation. McDonald and Eger test for this using a modified non-linear Durbin-Watson test, which is a metric used to determine the severity and direction of autocorrelation. The results showed no evidence of serial correlation.

McDonald and Eger break their non-linear least squares models into two categories; that is the direct and indirect[6] impact of defense spending on the post-Soviet economy. To be precise, the direct effects encompass a model that tests the relationship between various covariates and GDP growth. The indirect effects are models that are broken down further into two separate models; a model representing the relationship between the covariates and the investment ratio, and a model representing the relationship between the covariates and total unemployment. By splitting the analysis into direct and indirect effects, the effects of military expenditures can be refined into specific areas of the economy. (See Table 3-2 on next page)

[6] The indirect impact of defense spending encompasses two models, one that captures the effect of defense expenditures on investment, and another on employment. These are important to look at, since Benoit (1973) suggested that increasing defense burdens may be beneficial to employment.

Table 3-2: *Direct Impact of Defense Spending on the post-Soviet Economy*

Variable	Coefficient	t-Statistic
Model: Economic Growth **Dependent Variable: GDP**		
λ est.	-0.3545***	-3.03
ψ_1	0.0764	0.92
ψ_k	0.2969***	2.49
π_d	4.0031***	2.89
ψ_d	-0.0084	-0.29
π_n	1.6848***	7.18
ψ_n	0.358***	2.34
Fixed effects for year and country **R^2 = 0.8007** **N = 210**	Yes	
Labor Effect ($e^{\lambda t}$)	0.0270	
Investment Effect ($e^{\lambda t}$ ψ_k)	0.1052	
Defense Growth Effect (π_d(D/Y)+ ($e^{\lambda t}$ ψ_d)	0.0760	
Defense Size Effect ($\lambda\pi_d$)	1.4193	
Non-Defense Growth Effect (π_n(n/Y)+ ($e^{\lambda t}$ ψ_n)	0.2886	
Non-Defense Size Effect ($\lambda\pi_n$)	0.5973	

*Note: * Significance at 0.1*
*** Significance at 0.05*
**** Significance at 0.01*

Table 3-2 summarizes the direct effects, that is the model representing military expenditure's relationship with the coefficients as described below:

- λ represents technology
- π_d represents the productivity of the defense sector

- ψ_i represents the externality effect of the defense spending
- Subscript n refers to non-defense government sectors
- Subscript k refers to any individual post-Soviet State
- Subscript d refers to defense
- Subscript t represents the base year, 2000

Upon first perusal of the table, the results are contradictory, with a positive coefficient on the productivity of the defense sector and a negative coefficient on the externality effect of defense spending. The opposing association between these covariates leads McDonald and Eger to calculate the elasticity of total economic output, with respect to defense and non-defense spending, as labeled in the above table as Defense Growth Effect and Non-Defense Growth Effect. These "real effects" allow for a better comprehension and interpretation of the results. "Inferring from the additional calculations, a one percent increase in defense spending within the post-Soviet states is expected to increase the state's economic growth by about 0.08 percent, and a one percent increase in the ratio of defense spending to GDP will promote economic growth by 1.42 percent (McDonald, Eger, pg 17)." A one percent increase in non-defense spending will also increase economic growth by about 0.6 percent. The results of the direct model are consistent with the Structuralist school, as in this case, higher amounts of defense spending are associated with higher levels of economic growth.

The following two tables summarize the results of the indirect effects models, that is, the models that use Investment and Total Unemployment as response variables, respectively.

Table 3-3: Indirect Impact of Defense Spending on the post-Soviet Economy

Variable	Coefficient	t-Statistic
Model: Investment		
Constant	0.0551***	3.68
Private Sector$_t$	0.1287***	3.78
Private Sector$_{t-1}$	0.0751***	2.42
Private Sector$_{t-2}$	0.0380*	1.39
Defense Spending$_t$	-0.0954	-0.17
Defense Spending$_{t-1}$	*-0.2882*	-0.60
Defense Spending$_{t-2}$	-0.4025	-0.95
Non-Defense Government Spending$_t$	0.2763***	2.33
Non-Defense Government Spending$_{t-1}$	-0.1427*	-1.35
Non-Defense Government Spending$_{t-2}$	-0.1448*	-1.50
Capital Stock$_{t-1}$	0.5513***	7.54
Fixed effects for year and country	Yes	
R^2 = 0.4905 N =168		

Note: * Significance at 0.1

** Significance at 0.05

*** Significance at 0.01

Table 3-4: Indirect Impact of Defense Spending on the post-Soviet Economy

Variable	Coefficient	t-Statistic
Model: Total Unemployment		
Constant	7.1523***	5.52
$Unemployment_{t-1}$	0.7484***	9.88
$Unemployment_{-2}$	-0.1191**	-1.85
$Defense\ Spending_{t}$	0.0292	0.38
$Defense\ Spending_{t-1}$	*-0.0179*	-0.19
$Defense\ Spending_{t-2}$	-0.0204	-0.32
$Non\text{-}Defense\ Government\ Spending_{t}$	-0.3152***	-3.61
$Non\text{-}Defense\ Government\ Spending_{t-1}$	0.2324***	2.93
$Non\text{-}Defense\ Government\ Spending_{t-2}$	-0.0006***	-2.03
Fixed effects for year and country	Yes	
$R^2 = 0.8454$ N =182		

Note: * Significance at 0.1

** Significance at 0.05

*** Significance at 0.01

Analyzing Table 3-3, the Investment model, first, it is important to note that defense spending, regardless of the lag, is statistically insignificant and negative. Non-defense spending is initially beneficial to investment, but as time goes on, crowding out becomes an issue. These results are not surprising given how active the private sector is in its contribution to investment as a whole.

For Table 3-4, the Total Unemployment model, defense spending has a positive but insignificant coefficient. In the following two years, defense spending turns negative, while still

insignificant. This is contrary to Benoit (1973), who claimed that defense spending may have a positive effect on economic growth. Non-defense spending is statistically significant throughout all time periods, however the sign switches from t to t-1. As pointed out by McDonald and Eger, because the magnitude of these coefficients are roughly the same, the effect of non-defense spending may cancel itself out over time.

The implications of McDonald and Eger's work is compelling as military expenditures has a different impact on GDP, investment, and total unemployment. The first model, or the direct effects model using GDP as the response, showed a positive relationship between defense expenditures and growth. Conversely, both indirect models using investment and total unemployment as response variables, respectively, showed mostly negative and insignificant relationships. In this case, McDonald and Eger simultaneously are in the Structuralist school, given their contention of a positive relationship in the direct effects model, and the insignificant group, since the indirect effects showed no statistical relationship. To elaborate further on the indirect effects model, McDonald and Eger state "in the short term, non-defense spending promotes investment, but the effect does not last into the following years. Regarding employment, non-defense spending reduces total unemployment in the short term, but increases it in the long run (McDonald, Eger, pg 20)."

2010 ONWARD: CHAPTER 3-3

Casey Borch and Michael Wallace take a different approach than Sala-i-Martin and many other of their predecessors in the sense that their 2010 paper "*Military Spending and Economic Well-Being in the American States: The Post-Vietnam War Era*" focuses on the developed world. These are the cases in which it would be more likely to see potential positive externalities, as mentioned earlier, such as the external effects generated by research and development activities

or more employment opportunities. To support this hypothesis, Borch and Wallace (2010) frequently reference Groton, Connecticut, which is endearingly referred to as the "Submarine Capital of the World" (Borch, Wallace, pg 2)

In their 2010 paper, Borch and Wallace highlight a key characteristic of the United States throughout the Cold War period, which they have identified as "military Keynesianism", which parallels the "Structuralists" as described by Landau (1983). As cited by Baran and Sweezy in their 1966 paper, "if military spending were reduced once again to pre-Second World War proportions, the nation's economy would return to a state of profound depression, characterized by unemployment rates of 12 percent and up" (Borch, Wallace, pg 1727). More importantly, it is also argued that "government officials use military spending as a countercyclical tool to avoid recession, reduce unemployment, and stimulate economic growth (Borch, Wallace, pg 1727). Borch and Wallace also contend that this emphasis on military Keynesianism tends to "focus on the *cause* of military spending as opposed to the *outcome*" (Borch, Wallace, pg 1730). This distinction becomes important as they build their model.

The data is pulled from 1977-2004 from 49[7] states. This time period includes crucial historical moments, such as the fall of the Soviet Union, and more importantly, the multiple terrorist attacks that occurred in New York, Pennsylvania, and Washington D.C. on the morning of September 11th, 2001. These terrorist attacks mark an important date since military build-up in the United States increased dramatically in the years following.

The modeling technique employed by Borch and Wallace is unlike any of the other papers that we have discussed in the sense that they chose a "growth curve" model, which is a

[7] Borch and Wallace made no mention of which state was left out of the analysis.

statistical modeling method used to estimate positive or negative growth trajectories. Multiple generalized models are run for each state, which may or may not have different trajectories. Like McDonald and Eger, Borch and Wallace also utilized lags, however they chose a one year lag, instead. From this repeated modeling process, Borch and Wallace were able to draw conclusions across different states, and across different metrics including: median family income, income inequality, and unemployment rates.

The following tables summarize the results based on their growth trajectory. Table 3-5 shows the "initial status' of the variable, which is "the main effect coefficient represents the average effect of the independent variable at the first point in time (Borch, Wallace, pg 11)."

Table 3-6 represent the growth curve model with a linear trajectory. Furthermore, Table 3-6 breaks down military spending into various components, such as personnel and non-personnel. This distinction is important, as the relationship between the different types of military spending may make a different on the final conclusion.

For both tables, the X corresponds to a dummy variable that was used for certain models. For example, in Table 3-5, the X South corresponds to a dummy variable for the % of Black citizens in the South within the Median Family Income model.

Table 3-5: Results of Model Tests of Four Measure of Economic Well Being

Fixed Effects	**Unemployment Rate**		**Median Family Income (2000)**		**Income Equality**		**Poverty Rate**	
INITIAL STATUS	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*	*Coefficient*	*Std. Error*
Intercept	6.471*	(7.26)	50.463***	(27.8)	38.818***	(36.9)	12.983*	(9.42)
South	1.835**	(3.24)	-2.775	(1.24)	4.27***	(3.58)	-4.446***	(2.86)
Post Cold War (1990-00)	.152	(0.95)	-0.571	(1.92)	0.163	(0.75)	0.438***	(1.98)
Post 9/11 (2001-04)	0.890*	(3.42)	-1.276**	(2.61)	-0.467	(1.37)	0.854***	(2.10)
% Δ GDP per capita (t-1)	-0.291*	(15.5)	0.411*	(11.7)	0.058*	(2.32)	-0.236*	(8.71)
% Δ Aggregate concentration	0.123*	(3.59)	-1.246*	(7.11)	-0.009	(0.19)	0.583*	(4.47)
Inflation (t-1)	-0.278*	(12.0)	0.385*	(8.00)	-0.069**	(2.77)	-0.156*	(5.85)
% College graduates	0.019	(1.10)	-0.029	(0.73)	0.011	(0.41)	-0.073**	(2.76)
% Black	-.000	(0.02)	0.471**	(2.82)	0.140*	(4.67)	0.164**	(3.08)
X South	----		-0.526**	(2.70)	----		----	
Residential population/1,000	0.047***	(2.28)	-0.201	(1.45)	0.105**	(2.60)	0.273*	(5.12)
% Democrats in state government	-0.009***	(2.02)	0.043*	(3.79)	-0.008	(1.06)	-0.050*	(4.75)
X South	----		----		----		0.084*	(5.17)
Democratic governor	-0.564*	(3.69)	-0.034	(0.23)	-0.206	(1.94)	-0.117	(1.13)
Manufacturing/GSP	-0.007	(0.35)	-0.086***	(2.35)	-0.007	(0.35)	0.102*	(3.92)
% Employed in large establishment	-0.032	(1.58)	0.064	(1.20)	-0.138*	(3.67)	-0.208*	(6.32)
X South	----		----		-0.181**	(3.24)	----	
# Fortune 500 firms (log)	0.104	(1.06)	0.311	(1.34)	0.037	(0.25)	-0.839*	(4.41)
X South	----		----		----		0.965**	(3.23)
Union Density	0.049**	(2.87)	0.086*	(2.03)	0.045***	(1.98)	0.045	(1.64)
Non-defense/GSP (t-1)	0.261*	(8.16)	-0.550*	(11.8)	0.092**	(3.10)	0.301*	(7.18)
Defense contracts/GSP (t-1)	0.032	(0.54)	-0.216	(1.67)	-0.096	(1.17)	0.123	(1.35)
Defense personnel/ GSP (t-1)	-0.190*	(2.29)	0.294	(1.34)	-0.034	(0.33)	0.101	(0.75)

* Significant at 0.1, ** Significant at 0.05, ***Significant at 0.01

Table 3-6: Linear Growth Trajectory

Covariate	**Unemployment Rate**		**Median Family Income (2000)**		**Income Inequality**		**Poverty Rate**	
Trend(Linear)	-0.137*	(4.04)	0.843*	(12.7)	0.56	(1.18)	0.356*	(5.26)
X South	-0.040**	(2.70)	----		----		----	
X %Δ Aggregate Concentration	----		0.083*	(8.98)	----		-0034*	(4.94)
X Inflation (t-1)	0.009**	(2.97)	-0.051*	(8.15)	----		----	
X % Black	----		----		-0.002*	(1.99)	0.003**	(2.80)
X % Democrats in state government	----		----		----		0.002**	(3.17)
X Democratic governor	0.039*	(4.23)	----		----		----	
X Manufacturing/ GSP	-0.002***	(2.05)	----		----		-0.006*	(5.26)
X % Employed in large establishment	----		----		0.009***	(4.14)	----	
X Union density	----		-0.010**	(3.24)	----		----	
X Non-defense/ GSP (t-1)	-0.007*	(5.14)	----		----		-0.012*	(6.16)
X Contracts/GSP (t-1)	-0.006**	(2.02)	0.029**	(2.86)	-0.014***	(2.25)	-0.025***	(2.07)
X Personnel/ GSP (t-1)	----		-0.045**	(2.70)	----		-0.008*	(4.63)

*Note: * Significant at 0.1, ** Significant at 0.05, *** Significant at 0.01*

The conclusions drawn from Borch and Wallace's analysis proved surprising for all three responses[8]. Starting with the median family income model in Table **3-6**, Borch and Wallace reported that "neither coefficient [referring to the military spending variables], was significant at the 0.05 level, suggesting that the average level of military spending in the state does not affect median family income at the first time point" (Borch, Wallace, pg 1741). However, when taking into account the lag, Borch and Wallace disaggregate their interpretation of military spending into spending on defense personnel and spending on defense contracts[9], which is illustrated in table **3-6**. From this, Borch and Wallace contend that "there is a positive and significant[10] relationship between spending on contracts and median family income (Borch, Wallace, pg 1741)." Moreover, Borch and Wallace claim that "military spending staves off the deleterious effects of deindustrialization on economic well-being (Borch, Wallace, pg 1743)."

The implications of Borch and Wallace's 2010 paper provides support of their "military Keynesianism" hypothesis and the "Structuralist" school, including Emile Benoit, they make a definitive argument for disaggregating military spending into spending on personnel and defense contracts. An important distinction among the 2010 paper is the emphasis on short-term effects of military spending in the United States. This opens further avenues of research for those interested in "constant War State" and long-term consequences of defense spending.

[8] That is, the models that had the response variable set as median family income, income inequality, and unemployment.
[9] This distinction is important as defense contracts are carried through the private sector, whereas spending on personnel is completely within the public sector.
[10] Signifcant at the 0.01 level.

The final paper we will discuss is the 2014 paper, *"Does Military Spending Stimulate Growth? An Empirical Investigation in Italy"*, by Giorgio d'Agostino. The motivations and theoretical framework was inspired by Barro (1991). The theoretical model that d'Agostino implemented is an extension of the endogenous growth model as outlined in the previous chapter and is different in the sense that d'Agostino explicitly defines military expenditures as one of his covariates.

The data comes from a combination of the Italian government and NATO, due to their outlining of military expenditures. As described by d'Agostino, the definition of defense expenditures varies from country and unilateral organizations. Moreover, NATO defines defense spending as "all current and capital expenditure on armed forces, peacekeeping forces, Defense Ministry and other government agencies engaged in defense projects, paramilitary forces available for military operations, and military space activities" (d'Agostino, pg 6). The Italian government does not specify "peacekeeping missions and paramilitary forces" as *defense* spending, therefore, this distinction becomes important throughout d'Agostino's analysis, as these figures differ greatly.

d'Agostino addresses a different and relatively unexplored idea, that is, how the household is affected by an external threat, such as terrorism or war. The impact on an economy due a perceived *external* military threat is a good reason to use the endogenous growth model. d'Agostino is careful to add lags to account for the fact that there may be a delay in when the change in GDP is observed. From his preliminary analysis, d'Agostino states that "military burden has significant effects on economic growth, promoting "productively" peacekeeping and humanitarian missions which reduces the insecurity from the external threat (d'Agostino, pg

17)". This has interesting implications for nations who both give and receive funding for peacekeeping missions.

CHAPTER 4: DATA

A continuing issue in economics is the reliability of the data, particularly economic indicators from formerly authoritarian governments. We collected data on Percentage of GDP growth per year, Military Expenditures as a percentage of GDP per year, and NATO membership on 18 Eastern European countries [11] over the course of years from 1988-2014, from three major sources, the World Bank, the Stockholm International Peace Research Institute (SIPRI), and NATO, respectively. Our main focus will remain on formerly Communist countries in Eastern Europe.

4-1: WHY SIPRI?

While the choice of the World Bank and NATO as sources for data seem natural, for some, the Stockholm International Peace Research Institute (SIPRI) is relatively unknown. To give a comprehensive background, SIPRI was formed in 1966 with support of the Swedish Parliament to encourage further research in the area of defense and peace economics. "The SIPRI yearbook, entitled *World Armaments and Disarmament*, also includes very detailed statistics on arms trade and national defense industries, as well as abundant analytical studies concerned with the most recent political and strategic events (Herrera, pg 33)." Our values for military expenditures as a percent of GDP come from the Military Expenditure database.

[11] Our countries include the following: Belarus, Bosnia, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, and Ukraine.

Furthermore, the motivation for using SIPRI is further solidified in that "the definition of military expenditure adopted by SIPRI corresponds to the NATO reference classification, the standard definition of which is broken down schematically into: capital expenditure (including equipment of major importance, missiles, and infrastructures); and operating expenditure (including the cost of military personnel, purchases of munitions and explosives, supplies and consumables, and other defense expenditures.) (Herrera, 33)."

As previously illustrated by d'Agostino and other economists, it is paradigm that each institution's definition of defense spending is consistent across all sources of data.

4-2: Methodology

Our methodology is inspired significantly from the work of Xavier Sala-i-Martin. The goal of our analysis is to examine the relationship between percent of GDP growth and military expenditures as a percentage of GDP and NATO membership. As pointed out in Chapter 2-3 in the description of Landau, our hypothesis is consistent with the "Free Market Thinkers" and that for our sample of 18 Eastern European (as listed in a footnote on the last page) countries, we expect to see a negative relationship between our covariates, namely, military expenditure as a percent of GDP and NATO membership, and our response, GDP growth. Our hypothesis coincides with the Free Market Thinkers given the history of these previously authoritarian countries.

For an interesting and informative view on the Soviet Union, a detailed book published in 1991 by Eugene Keefe can be referenced. Throughout the Soviet Union's history, along with

the Republics and Satellites[12], many of these countries opted for the "largest" and most threatening military, granted, the quality of such military was lacking. Artillery and tanks were built for the sake of building tanks, along with giving the country's citizens work[13]. With that being said, there were likely better uses of these capital and human inputs, and that many of these countries are still recovering from the negative effects of maintaining a poorly designed and executed military. This would align with the Free Market Thinkers.

The following table represents the summary statistics on our countries.

- Y represents GDP growth
- ME represents Military Expenditures as a percentage of GDP

[12] As mentioned in Keefe's book and other historical sources, a Soviet "Republic" refers to a country that was essentially annexed by the USSR and deemed an auxiliary administrative center. "Satellites refer to a country surrounding the Soviet Union that were not part of the Soviet Union but strongly influenced by the USSR. One could call them a Soviet "Puppet State".

[13] Please reference Policy Analysis: Perestroika and the Soviet Military: Implications for U.S. Policy by Edward A. Corcoran for a more descriptive view on the Soviet Military.

Table 4-1: Summary Statistics

Country	Variable	Obs	Mean	Std. Dev.	Min	Max
Belarus	ME	22	1.6069	0.5555	1.1981	3.6216
	Y	24	3.1517	6.9275	-11.7	11.449
Bosnia-Herzogovina	ME	12	1.5901	0.8295	1.1030	3.9043
	Y	27	1.4486	5.2026	-9.117	10.944
Bulgaria	ME	25	2.5339	0.63758	1.54831	4.3963
	Y	20	11.0671	20.1722	-2.8698	88.9576
Croatia	ME	22	4.3573	3.4138	1.6496	11.1481
	Y	19	2.0373	3.6494	-7.383	6.6454
Czech Republic	ME	21	1.6831	0.3662	1.0496	2.3304
	Y	24	1.703	3.9885	-11.6149	6.8765
Estonia	ME	21	1.5559	0.4512	0.7617	2.2708
	Y	19	4.4221	6.2267	-14.7244	11.7986
Hungary	ME	26	1.7491	0.6873	0.9299	3.8032
	Y	23	1.8391	2.8255	-6.5591	4.9377
Latvia	ME	21	1.6520	0.6162	0.8645	2.6360
	Y	19	4.3511	6.2186	-14.3489	11.9021
Lithuania	ME	21	0.9671	0.2736	0.4523	1.3656
	Y	19	4.5322	5.5704	-14.8141	11.0869
Macedonia	ME	18	2.2264	1.1981	1.2377	6.5839
	Y	24	1.2608	3.9283	-7.4692	6.4734
Moldova	ME	21	0.5211	0.1985	0.3155	0.9259
	Y	27	-0.5122	10.2999	-30.9	9.3968
Montenegro	ME	17	2.4402	4.8434	-9.3999	10.6579
	Y	24	1.703	3.9885	-11.6149	6.8765
Poland	ME	8	1.8202	0.2330	1.4988	2.3128
	Y	24	3.678	2.1940	-7.0155	7.2016
Romania	ME	26	2.0129	0.2315	1.7659	2.6124
	Y	24	1.7593	5.5888	-12.9182	8.4589
Serbia	ME	26	2.5758	1.1257	1.2659	4.7597
	Y	19	2.8178	4.9349	-12.1465	9.0465

Slovakia	ME	21	1.7716	0.5508	1.0005	10.834
	Y	22	4.072	3.3599	-5.4913	10.8344
Slovenia	ME	22	1.4559	0.2552	1.0549	2.2472
	Y	19	2.5572	3.4011	-7.7972	6.9416
Ukraine	ME	21	2.7646	0.6819	0.4653	4.1246
	Y	27	-1.2027	8.7639	-22.9341	12.1

4-3: MODEL

We chose to implement an OLS regression along with a year lag for all of our values. A greater lag may be more appropriate in other cases, however, given the short time period for which we have data, we selected the year lag. Our model framework is set up as the following:

(4-1)…….$\widehat{Y_{it}} = \hat{\beta}_0(ME_{it-1}) + \hat{\beta}_1(NATO_{it-1}) + \hat{\beta}_3(ME_{it-1} * NATO_{it-1})$

The terminology for the model is as follows:

- Y represents % of GDP growth
- ME represents Military Expenditures as a percentage of GDP
- The variable, NATO, is a dummy variable coded as 0 or 1, 1 for NATO membership and 0 for otherwise.
- Subscript i refers to country
- Subscript t refers to time

The interaction between ME and NATO is included to further analyze how NATO membership affects growth. This is an important distinction because member countries must comply with the limitations on military spending set forth by NATO. At first glance, it is

difficult to assess what the relationship with the interaction between ME and NATO might be.

We also compare correlations between ME and GDP growth controlling for NATO status and NATO and GDP growth controlling for ME for a general idea of the relationships. Looking at the relationship between ME and GDP growth, most countries exhibited positive relationships, however, many were statistically insignificant, or at best, marginally significant. However, this relationship may change as we add NATO and our NATO interaction into the model. It is also likely that there are effects that ME is not capturing and could be seen using a combination of other predictors, likely missing variables that may be correlated to ME and then yielding biased results of the relationship between ME and Y. The following table summarizes the results of the correlation between ME and GDP growth.

Table 4-2: Correlations between ME and Y ignoring NATO status

Country	Covariate	Coefficient	Std. Error
Belarus	Constant	16.988*	3.2664*
	ME	-8.1268*	1.9258*
Bosnia-Herzegovina	Constant	0.3492	2.2982
	ME	1.8467	1.2930
Bulgaria	Constant	-7.9612	26.67
	ME	8.1854	11.3049
Croatia	Constant	0.5153	1.3486
	ME	0.4356	0.30759
Czech Republic	Constant	-5.1437	2.5422
	ME	4.5538***	1.4775
Estonia	Constant	14.1962**	5.5958
	ME	-6.0145*	3.3425
Hungary	Constant	1.1749	2.3723
	ME	0.0575	1.4743
Latvia	Constant	5.8481	4.3792
	ME	-0.8764	2.4166

Lithuania	Constant	5.8231	5.3261
	ME	-1.2906	5.1605
Macedonia	Constant	3.2126	1.2637
	ME	-0.1415	0.5029
Moldova	Constant	11.1634**	5.1974
	ME	-18.8498*	9.3479
Montenegro	Constant	-14.5130	14.8007
	ME	9.3619	8.0733
Poland	Constant	11.8583**	5.5414
	ME	-4.0881	2.7542
Romania	Constant	7.8979***	2.7365
	ME	-2.5427**	1.0491
Serbia	Constant	-0.8087	4.0751
	ME	1.0483	1.1985
Slovakia	Constant	0.1284	2.4410
	ME	2.28429*	1.3184
Slovenia	Constant	2.0772	7.0713
	ME	0.34663	5.07336
Ukraine	Constant	-19.712	7.2049
	ME	7.1260	2.5337

* Significant at 0.1, ** Significant at 0.05, *** Significant at 0.01

From **Table 4-2**, we can see that most of the correlations are insignificant. Sorting the countries based on their NATO status did not seem to change this relationship much. Unfortunately, many of these correlations remain statistically insignificant.

4-4: ANALYSIS

In order to scrutinize the results, we run several models with and without the fixed effects with a lag, given by expressions (4-2) and (4-3) located below, respectively. Given what has

been suggested in previous studies, the use of lags tends to give a better fit, as we would not expect changes in GDP growth to happen immediately. It is also paradigm to use a fixed effects model to analyze each country. While each country was either a former Soviet Republic or a member of the Iron Curtain, each country has its own specific characteristics that may or may not change the relationship with the covariate. Previous literature all seems to support the use of fixed effects. For this reason, our final model, as described in tables below, is a fixed effects model with a one year lag. **Table 4-3** describes fixed effects by country and year.

(4-2)…….. $\hat{Y}_{it-1} = \hat{\alpha}_i + \widehat{\alpha_t} + \hat{\beta}_1(ME_{it-1}) + \hat{\beta}_2(NATO_{it-1}) + \hat{\beta}_3(ME_{it-1} * NATO_{it-1})$

(4-3)…….. $\hat{Y}_{it-1} = \hat{\alpha}_i + \widehat{\alpha_t} + \hat{\beta}_1(ME_{it-1}) + \hat{\beta}_2(NATO_{it-1}) + \hat{\beta}_3(ME_{it-1} * NATO_{it-1})$

Table 4-3: Fixed Effects Model lagged by One Year

Country	Coefficient	Std. Error	Year[1]	Coefficient	Std. Error
Belarus	----		**1993**	4.1661	3.7243
Bosnia	-2.5393	2.3138	**1994**	7.3622	3.7537**
Bulgaria	5.0997	1.908***	**1995**	9.02725	3.3238*
Croatia	--4.8805	2.1199**	**1996**	24.9508	3.3197*
Czech Republic	-3.155	2.1477	**1997**	8.3328	2.667*
Estonia	-1.681	1.9699	**1998**	1.9203	2.1521
Hungary	-6.2909	2.0828*	**1999**	0.57494	2.0777
Latvia	-0.6305	1.957	**2000**	2.9785	2.0437
Lithuania	-2.9079	2.0547	**2001**	2.6701	1.9886
Macedonia	-3.3642	1.9394***	**2002**	3.5144	1.9596***
Moldova	-1.9932	1.8384	**2003**	4.2972	1.9494**
Montenegro	-2.8227	3.0268	**2004**	5.157	1.8474*
Poland	-2.9360	2.0199	**2005**	4.6501	1.8465*
Romania	-0.4612	2.2448	**2006**	5.6008	1.8567*
Serbia	-3.0859	2.0712	**2007**	5.6902	1.8241*
Slovakia	-2.2744	1.9801	**2008**	2.5283	1.8196
			2009	-7.8755	1.8111*
Slovenia	-4.4652	1.9810**	**2010**	0.7712	1.8112
			2011	1.8991	1.7776
Ukraine	-3.3182	1.8491***	**2012**	-1.2030	1.7755
			2013	0.3707	1.7747

	Coefficient	***Std. Error***
ME	**0.00000165**	**0.0000331**
NATO	**6.9685**	**2.4841***
ME*NATO	**-0.004183**	**0.0001009***
Constant	3.6938	1.8386**

*** Significant at 0.1, ** Significant at 0.05, * Significant at 0

[1] 1989-1992 and 2014 were omitted from the analysis on the grounds of collinearity.

Table 4-3 has some compelling results to take note of. Belarus was also omitted from the model due to multicollinearity issues. We can see that ME coefficient was positive, albeit incredibly small, but also statistically insignificant. The NATO dummy is positive but is also statistically insignificant. The sign of the NATO dummy is opposite of what we had initially expected, although one can argue, as mentioned in the introduction, that many of these NATO countries are then no longer responsible for providing a military stronghold in their region due to the overwhelming presence and strength of the US in NATO. We were not sure on what the sign of the interaction would be, however in this case, it is negative. A non-NATO member of the former Iron Curtain will see a 0.00408% increase in growth given a 1-percentage point increase in ME, holding all else equal. This of course must be taken with precaution as the ME coefficient is statistically insignificant.

Our main interest is in what the net effect is of ME controlling for NATO membership. Based on the above table, we cannot tell whether or not that coefficient, which is represented by $\widehat{\beta_1} + \widehat{\beta_3}$, is significant or not, although the sign is negative, -0.01762. Despite this, we would say that a NATO member would see a decrease in GDP growth by a value of 0.1123% if ME increases by 1-percentage point, holding all else equal.

We performed an F-test to detect significance, to which we got an F-statistic of 2.54 and a p-value of 0.1123. Using stringent guidelines, we would classify the net effect of ME to be negative and statistically insignificant, although one could argue that it is marginally significant.

Looking at the fixed effects relationships year by year, the results are intriguing, however, not surprising. It is noticeable how much stronger these economies were during the

Clinton presidency in the 1990s or even perhaps riding the coattails of the "dot com" boom. A sharp fall in GDP occurs in 2009 as a result of the Great Recession, and growth since then has been relatively slow. Fixed effects by country are similar, although Bulgaria appears to be an isolated case since the sign is positive. However, we do not have adequate information to make any assumptions as to why that is.

Overall, we are hesitant to make a final assessment on how ME affects GDP growth. While statistically insignificant, it is important to recognize the vast differences within each country that may affect its level of economic growth. Perhaps a more in depth, individualized analysis would be more appropriate.

CHAPTER 5: CONCLUSION

Consensus amongst economists on the effects of military expenditures and economic growth is widely lacking. Theories can be broken down into two schools of thought, the Structuralists and the "Free Market Thinkers". The Structuralists contend that defense spending can actually increase economic growth through higher employment and the contribution to building infrastructure. Free Market Thinkers argue the opposite, and that increasing defense spending leads to "crowding out". Some economists claim there is no relationship between the two at all.

The previous literatures are divided by generational differences, the First Generation (1970s-early 1990s) being the more theoretical, and the New Generation (1990s onward), employ more econometric methods for their analysis. Our model was inspired by the pioneer of the New Generation, Xavier Sala-i-Martin. After running a lagged fixed effects model, our results were inconclusive, much like those of Sala-i-Martin. However, in our case, we have 18

countries, all from about the same area. We may have all of our countries in the same region, but that does not imply that these countries actually are the same. For a more comprehensive analysis on growth and defense expenditures, we believe a more individualized approach would be more appropriate.

In the case of the former Soviet satellites and Republics, it may also have to do with the NATO presence of the United States. For example, many of the tanks that arrived in the Ukraine as part of support against the Russian invasion of Crimea are primarily American, despite the closer, (and likely even better quality) tanks from Germany. As long as these countries remain militarily overshadowed by a global policeman, like the US, it may be difficult to make a realistic conclusion.

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