

# The Economic Effects of Military and Non-Military Government Spending

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## I. Abstract

There has been substantial investigation into the influence of government spending in general on economic growth, unemployment, and inequality, but relatively little investigation into the relative effects of different types of spending. This thesis attempts to separate the influence of military and non-military government spending on the economy. As with many such investigations, it focuses on a single economy – that of the United States. The results indicate that, dollar for dollar, military spending is just as effective as non-military spending at affecting unemployment, but much more effective at promoting short-term growth. Neither type of spending has a strong impact on income inequality, suggesting that the primary determinants of that are not related to government spending.

## II. Introduction

This topic is motivated by the political and economic divide on this issue. In American and Western European politics, political liberals tend to support increased non-military government spending but oppose increased military spending, while political conservatives tend to hold the opposite positions. Although these positions are partially supported by moral or ethical arguments, they are usually also justified by their purported economic implications. For instance, conservative economists such as Martin Feldstein (Feldstein 2009) advocated that the 2009 US stimulus package “include higher defense outlays”, with the argument that military spending provides a more rapid boost to GDP and employment than comparable amounts of civilian spending, partially because it is more likely to involve “American-made products”.

Similarly, one of the justifications for extending unemployment insurance came from the liberal side, with economists such as Paul Krugman arguing that “it has become clear that the [American Recovery and Reinvestment] act did a vast amount of good. It helped end the economy’s plunge; it created or saved millions of jobs” (Krugman 2014). As these examples illustrate, there is high demand for additional evidence regarding the economic effects of military and non-military government spending. The goal of this thesis is to investigate the economic effects of military and non-military government spending. In particular, I investigate the relationship of military and non-military spending to GDP growth, unemployment, and inequality.

There is a vast array of economic studies that have been done to investigate the relationship between government spending and economic performance. These can be roughly divided into two categories – studies that examine the business cycle effect of government spending, and studies that examine the growth effects of government spending. For the purposes of this investigation, the primary concern is the long-term relationship between government spending and economic growth, so the most relevant literature is in the second category. Within the neoclassical school of thought, the economic model in most widespread use is the endogenous growth model. This model attempts to explain long run economic growth by looking at the productivity of labor, the accumulation and value of capital, population growth, and the rate of technological progress. A key point of this model is that the long-run growth rate is endogenously determined – government policies promoting innovation and investment in human capital can have real, long-term effects on growth rates. Over time, growth rates will converge to the level of technological progress and labor force growth.

However, simply saying that government spending should attempt to increase the rate of technological progress or investment is not particularly helpful to a policymaker. Ostensibly, both military spending and non-military spending can and do contribute to technological progress and investment. On the military side, programs designed for the purpose of national security, such as ARPANET and the Manhattan Project, have often turned out to have valuable civilian applications. Meanwhile, direct civilian research also provides substantial technological benefits. Even seemingly-unrelated government programs like public education or subsidized medical care can contribute to technological development by giving more individuals the opportunity to pursue technology- or innovation-based jobs. This thesis will contribute to this area of inquiry by specifically examining the different effects of military and non-military government spending on growth, unemployment, and economic equality. The information gained can help inform policymakers' decisions about where to direct government resources to achieve their economic and social goals most effectively.

This thesis is divided into three main parts. The first part is a literature review, wherein I examine some of the most important writings on the relationship between economic performance and government policies. This helps to develop a theoretical framework for the analysis and provide some context for analyzing the results. Next, I specify in greater detail what kind of data will be used and how it will be analyzed. Finally, the last section consists of the regressions that have been run on the data and an interpretation of their results. The results for growth confirm my hypothesis about the sign of the effect of government spending, but contradict the hypothesis that non-military spending is more effective than military spending. The results for unemployment and inequality are more ambiguous.



### III. Literature Review

The literature upon which this section is based focuses on the impacts of government spending on growth, unemployment, and inequality. There has been substantial research on each of these topics, but the majority of the research focuses on the impact of either total government spending or budget deficits. Since government spending is not broken down into military v. non-military, the primary purpose of these subsections is to generate a benchmark for what the overall effect should be. If the results deviate substantially from the results of this research, then some explanation of differences in methodology will be required. Obviously, there is a vast body of literature on the effects of government spending on growth, unemployment, and inequality, so literature was chosen based on its relevance to the specific topic of military v. non-military spending. The second part of this literature review considers studies specifically of the differences between military and non-military spending. The results from these studies help provide context for my investigation as I determine how the differences in impact relate to the unique qualities of military and non-military government spending. As we shall see, there is no systematic agreement on the effects of military and non-military spending; instead, there are multiple schools of thought, each of which postulate different effects based on different theoretical explanations. The results of my study will help to determine which model(s) are correct and how the assumptions they make relate to reality.

#### **Effects of Government Spending on Growth:**

The effects of government spending on economic growth is one of the most-studied topics in macroeconomics, but there is far from a consensus on its precise effects in various situations. A common rationale for government spending is that it can correct for externalities. Even in an idealized free market, perfect competition will not produce the optimal result for

society if certain goods or methods of production have externalities – societal effects not captured in their price or cost of production. If government can recognize and correct for these externalities, the efficiency of the market will be improved, which promotes economic growth. The concept of positive externalities is particularly important when it comes to analyzing increasing or decreasing marginal returns (Barro 1990). While private returns to scale on certain factors of production may be diminishing, social returns that include potential positive externalities can achieve constant or increasing returns. When Barro took into account social returns on the individual factors of production, he was able to establish evidence that endogenous growth doesn't require exogenous changes in technology or population, because certain factors of production can be accumulated. As a result, government spending on sectors of the economy with significant externalities can promote long-term economic growth.

But how is this government spending to be paid for? In general, the government can finance spending either through taxation or taking on debt. Taxation is relatively easy to model since all of the changes are occurring in the present period, but government debt is a trickier subject. In some models, economists focus on the direct results of debt in the present economy, examining concepts such as the “crowding out” effect of government deficits on private investment (Siddiqui and Malik 2001). However, it is also important to consider the predictive abilities of market participants: if economic agents see government debt increasing in the present period, then they can predict that there will be higher taxes and/or inflation in the future (Barro 1980, Aschauer 1985). Both of these economists assert that, given higher government debt and the prediction of higher taxation or inflation in the future, economic agents will attempt to maximize the present value of their lifetime utility by “smoothing” consumption. This replaces the first-order macroeconomic effects with intertemporal substitution effects. In

general, economic agents will increase work effort and output in the current period while reducing spending. In contrast to theories of crowding out effects, wherein government investment can reduce private investment, these results imply that government investment can stimulate private investment, at least in the short term.

The other possible method of financing government spending is through taxation. Taxation and government borrowing both have significant effects on the market that cannot be assumed away when looking at spending, so it is important to consider how different types of taxes change the market. Typically, economists assume that the optimal method of taxation is lump-sum taxes, since they introduce the fewest distorting effects. However, in some cases lump-sum taxes may not be optimal (Barro and Sala-I-Martin 1992). For instance, taxation can be used to provide an incentive for private investment rather than consumption. If the societal rate of return on investment exceeds the private return, which is often the case for research with substantial spillover effects, then pro-investment tax policies can promote economic growth in the long run as well as the short run. Additionally, income tax works approximately as a user fee for non-excludable public goods subject to congestion, including transportation facilities and police forces. The benefit to high-income citizens for these goods tends to be greater than the benefit to low-income citizens, so progressive income taxes can more correctly apportion the costs to the beneficiaries.

To make things more complicated, one of the key assumptions of all of these models of government spending – that government spending shocks are completely exogenous and have crisp, well-defined start and end points – is completely untrue (Ramey 2011). Market participants can and do attempt to predict how the government will behave in the future, and they frequently anticipate changes to government spending before they are even proposed. For



instance, if market participants note that the economy is going through a significant recession, they could intelligently predict that there is a greater possibility of increased government spending in the future. As a stimulus bill is proposed, debated, and finally passed, the market becomes more and more certain that government spending will increase. As a result, economic agents can “price in” the anticipated effects of future government spending into their decisions. This leads to the rather surprising result that government spending shocks can have an effect on the market before they ever occur. An economic model that assumes that all government spending shocks are completely exogenous would therefore return an incorrect result. Anticipated effects are particularly significant when it comes to military spending: for example, Lloyd’s of London stopped trading in war insurance in 1936, three years before World War II began in Europe (Tooze 2006).

Ramey attempts to mitigate these issues by investigating narrative approaches to identifying spending shocks, particularly defense spending shocks, by analyzing *Business Week* in relation to several wars and national security crises. Her goal is to identify the point or range in time during which the market first began to anticipate the increase in government spending, in order to more accurately measure its effect. Such investigations, though, are more an art than a science, since market sentiment is necessarily a latent variable. The best way to measure the sentiment of the market, economic performance, is precisely what is being measured as a result of the market, so economists are confined to fuzzy and difficult qualitative methods of analysis. Due to the lack of available data and theoretical backing for defining “market sentiment”, it will be largely excluded from this analysis. However, analyzing the relationship between various time lags of the independent variables could provide some intuition as to the anticipatory ability of the market.

**Effect of Government Spending on Unemployment:**

Closely related to growth is the unemployment rate. Unlike GDP, the unemployment rate doesn't have a definite long-run trend, but it can be considered a measure of how efficiently the economy is employing its human capital. There are two additional important components to the unemployment rate: structural unemployment and cyclical unemployment. Cyclical unemployment is unemployment due to changes in the business cycle. Although it is, by definition, a short-run phenomenon, it can have long-term effects. Hysteresis – the decrease in future potential output caused by a present-day recession – is partially caused by large or long-lasting cyclical unemployment (Delong, Summers, Feldstein and Ramey 2012). Workers who are unemployed for long periods of time may lose job skills (or be perceived as such by employers) and financial struggles may cause individuals to forego educational or professional development opportunities. Cyclical unemployment is highly dependent on government spending; whereas the private sector tends to reduce spending during recessions due to lack of demand, potentially creating a vicious cycle, government spending often holds constant or increases during recessions. The relative efficacies of military and non-military spending will depend on the short-run multiplier effect of spending on those sectors.

On the other hand, structural unemployment is unemployment caused by a mismatch between the qualifications of the unemployed and the needs of employers. Unlike cyclical unemployment, structural unemployment can last for long periods of time and cause significant long-run economic harm. There are a variety of proposed causes for structural unemployment, ranging from obsolescence due to technological development to foreign competition in key industries. Like cyclical unemployment, structural unemployment has the potential to significantly alter the long-run growth curve for an economy through hysteresis, but its

relationship with government spending is somewhat different (Mocan 1999). The only fundamental solutions to structural unemployment are to either change the skillset of the unemployed workers, or change the skillset required by employers to match that of the unemployed works. This could suggest that non-military spending would be a more effective counter to structural unemployment, as skills gained in the civilian industry would more directly translate to private-sector jobs.

### **Effect of Government Spending on Equality:**

Unemployment and GDP are by far the most widely-cited measures of economic performance, but they don't tell the entire story. Politically speaking, policies which produce a vibrant and rapidly-growing economy in which all of the growth in income comes from the top 1% are unlikely to be popular. While some level of income inequality is unavoidable, high levels of income inequality may prevent the vast majority of the population from having access to education, proper nutrition, etc. at a young age, limiting their productivity in the long run. Controlling income inequality, therefore, should be a component of any government economic policy. In general, the relationship between income inequality and growth is mixed. There is some evidence that inequality slows growth rates in poorer countries while increasing them in richer countries; however, there is also a negative correlation between GDP per capita and inequality (Barro 2000). This could potentially suggest that there is an "ideal" rate of inequality that brings about the highest possible GDP growth, and that richer countries tend to be less unequal than this ideal, while poorer countries tend to be more unequal than the ideal. On the other hand, it could be that the effects of inequality on growth depend on economic structure, and rich countries simply have a different economic structure than poor countries. In the absence of



clear theoretical backing for a causal relationship one way or the other, this thesis will simply include both inequality and growth as explanatory factors for the other.

Income inequality is also closely related to unemployment. Unemployment has the potential to both bring about inequality and deepen inequality beyond what differences in income alone would indicate. First of all, low-paid or unskilled workers tend to have substantially higher unemployment rates than the general populace. For example, in 2012, workers who lacked a high school diploma had an average unemployment rate of 12.4%, whereas workers with a graduate or professional degree had unemployment rates of 2.5% and 2.1%, respectively (Bureau of Labor Statistics 2013). This imposes an additional burden on workers who already have lower average wages even when they are employed. As a further negative effect, structural unemployment can generate inequality even amongst workers whose wages, when employed, are average (Mocan 1999). When entire classes of work become obsolete or subject to intensified foreign competition, workers in those sectors tend to suffer long-term unemployment. As with any change whose effect is concentrated on a small group, this will bring about an increase in economic inequality.

Government spending itself can also be either a cause of or a mitigating factor to income inequality. Obviously, by providing social services such as free public education and, in developed countries other than the US, free medical care, government spending reduces both short-term and long-term income inequality. However, a more interesting question is whether direct government transfers and tax policies such as food stamps or a progressive tax code reduce inequality, or simply mitigate it. In other words, do these programs cause pre-tax incomes to converge, or do they only insulate individuals from the full effects of unequal incomes? Empirical evidence suggests that the latter is true (Frenette, Green, and Milligan 2009).



Mathematically, this implies that measures of income inequality such as the Gini coefficient will return significantly different values when applied to pre-tax income versus income with taxes and transfer payments included.

Another implication of this result is that the type of government spending is likely to have a large impact on whether or not it helps to mitigate income inequality. Whereas the majority of non-military government spending either benefits all members of society (i.e. infrastructure, basic scientific research, retirement insurance) or is directed at alleviating poverty (i.e. welfare, subsidized housing), military spending is directed at a single economic sector. As would be expected from this differential, there is substantial evidence that military spending can increase income inequality (Abell 1994). This association occurs for a number of reasons, including pay differentials in civilian and military work, fewer opportunities for women and minorities at military contractors, and the greater profitability of military contracts relative to civilian production. Based on these sets of evidence, we would expect to see a negative or insignificant long-term relationship between non-military spending and income inequality, but a positive relationship between military spending and inequality.

#### IV. Military v. Non-Military Spending

Most literature on government spending considers it as a single factor,  $G$ , representing total government spending. However, there is substantial evidence to suggest that not all types of government spending are the same, and so it is worthwhile to break down the individual types of spending to analyze their effects separately. The evidence presented thus far generally supports the notion that non-military government spending, or even total government spending, has

a positive relationship with economic growth. Therefore, the first question to consider is: what is the relationship between military spending and economic growth? The answer to this question is far from clear-cut, and it depends on a number of factors, including baseline military spending rate, economic structure, and present unemployment level.

Defense spending has three main effects on the economy (Heo and Eger 2005). First, it has a direct crowding-out effect whereby investment and capital allocated to military ventures is unavailable for civilian applications. Although technology developed for the military may be adapted for civilian purposes, it is an imperfect substitute for direct civilian spending. Second, greater government spending in general, including greater military spending, stimulates economic growth and investment as predicted by Keynesian economic theory. Finally, defense spending, like other types of spending, must be paid for in taxes, deficits, and/or inflation (due to printing money). Any of these will have a negative effect on the economy. The latter two of these effects are common to both military and non-military spending, so the main difference is the differentials in public utility for the two types of spending. Since military spending is generally less useful in this sense, this theoretical framework suggests that military spending has an inferior relationship to economic growth as compared with non-military spending.

There is substantial empirical evidence to support these propositions. By comparing the United States to countries with similar economic systems but significantly less defense spending, such as Germany and Japan, Lapidus (1993) notes that increased military spending leads to a reduction in public capital expenditures. As per the theory indicated above, he ascribes this to the crowding-out effect of military spending. On a governmental level in particular, military spending could have a greater crowding-out effect because, if policymakers are unwilling to raise taxes or increase deficits, increases in military spending must come directly from decreases in

non-military spending. A key contribution of this article is to note that merely totaling the budget of the Department of Defense is not a valid way to measure total military spending. Military spending also includes foreign military assistance, veterans' benefits, military research done by NASA, and nuclear-weapons expenditures under the Department of Energy. By this standard, in 1989 employment by the military-industrial complex accounted for 4% of the overall economy, rather than the 1.3% indicated by conventional analysis. This is an important issue for this thesis to ensure that military spending is correctly accounted for.

Although literature generally supports the idea that government spending on the military crowds out non-military spending, the broader statement that military spending crowds out investment in general is more controversial. Indeed, some studies suggest little to no impact of military spending on the private sector (Du Boff 1989, Heo 2010). For the private sector, the crowding-out effects of military spending must be counted against the stimulative effect of government spending in general. As a result, there is actually a positive relationship between military spending and private-sector expansion. During periods of high unemployment, any stimulus is better than no stimulus, so by reducing hysteresis military spending can promote economic growth. The power of this effect can be seen by the fact that, contrary to popular opinion, military spending at the level seen in the early 2000s did not have a significant short-term effect on the US economy, despite the fact that unemployment rates were already relatively low (Heo 2010). This further muddies the water as to the impact of defense spending on economic growth, particularly in the short term.

Perhaps a better standard of comparison is to consider the *relative* effects of military spending as compared with non-military spending, rather than the absolute effects. Here, the results are somewhat clearer. Using cointegration to increase the power of his test, Atesoglu



(2004) analyzed the relationship between defense spending and investment in the United States and found that higher defense spending leads to greater investment and growth. However, its effect was much smaller, dollar for dollar, than non-military spending. On average, his model predicts that a 1% rise in non-military government spending would bring about a 3% rise in investment, but a 1% rise in defense spending only yields a 0.5% increase in investment. This is a much more economically valuable result, since in the real world the tradeoff is usually between military or civilian spending, not between military spending and nothing. That said, good economic arguments do not always readily translate to good political arguments. Despite the fact that military spending is less efficient at promoting investment than civilian spending, shifts in military spending have historically tended to be much larger than shifts in civilian spending (Muthuchidambaram 1992). For instance, federal government spending as a percentage of GDP more than quadrupled during World War II, but increased by less than 80% from the trough of the Great Depression to the height of the New Deal (Chantrill 2013). Politically, then, increased military spending may be worthwhile even if its economic benefits are smaller than non-military spending simply due to the greater ease of finding political support.

As the literature implies, the economic effects of defense spending on economic growth are a matter of contention among economists. For those who believe it has a negative effect, the key issue is that defense spending “preempts scientific and engineering talent from other potentially productive endeavors, drains R&D funding, usurps money from infrastructure investment, and adds to budget deficits which in turn raise interest rates” (Lapidus, 1993). When the government spends more on defense, it is likely to spend less on investments, such as infrastructure and civilian scientific research. This can cause other government-directed sectors of the economy to suffer neglect as resources are diverted to the military (Du Boff 1989). A key



assumption of this argument is that military spending is inherently less productive than civilian investment. Even though some military technologies have later been repurposed for civilian uses, it makes sense that direct investment in civilian technology would produce more benefits for the same amount of spending. Comparisons to countries like Japan and Germany with substantially lower rates of military expenditures also indicate that there may be diminishing marginal returns to defense spending. Therefore, increasing spending beyond a certain point may reduce the positive effects and increase the negative effects of defense spending.

Another camp of economics claims that the opposite is true. Rather than crowding out investment, defense spending promotes it. Using a cointegration technique to relate defense spending and private investment, Atesoglu (2004) concludes that there is a positive relationship between defense spending and investment, rather than a tradeoff. In this view, the effects of government spending in general are sufficient to outweigh any potential negatives stemming from military spending vis-à-vis non-military spending. However, even among economists who believe that military spending is beneficial, many of them still note that defense spending is less effective, dollar for dollar, than civilian spending. Although Atesoglu concludes that military spending can have a positive effect on investment, he also notes that civilian spending has a much greater impact. The main reason that defense spending would still be worthwhile in this paradigm is political. It is often politically easier to increase and maintain high rates of defense spending than it is to increase non-military spending, so there could still be a role for defense spending in promoting economic growth. Answering political questions like this one is outside the scope of this thesis, but the results of the data analysis can inform those decisions.

## V. Empirical Specification

Like many other studies of government spending, I have answered my thesis question by focusing on the macroeconomic data for the United States. I have examined key macroeconomic indicators in order to determine their relationship with military and non-military government spending. To gauge the results, I have looked at three key macroeconomic indicators: GDP growth, unemployment rates, and economic equality. The regressions also consider changes in interest rates and tax rates in order to control for the effects of government financing decisions and monetary policy. All of these factors are related to government spending in different ways, so they have been useful for identifying the effects of government spending on the economy. As the literature review suggests, many of these factors relate differently to government spending on military and non-military sectors of the economy, so I attempt to analyze and quantify these differences. This is the primary source for empirical evidence on the different economic effects of the two types of government spending.

The data for this analysis comes from a variety of sources. The US GDP growth rate is recorded by the Bureau of Economic Analysis, which provides nominal yearly data going back to 1914. To get the real GDP, the Consumer Price Index was used to denominate all of the values in 2010 dollars. Unemployment information is gathered by the US Bureau of Labor Statistics. Unemployment data is available on a monthly basis going back to 1948; however, due to the limitations of explanatory variables, only yearly data was used. Finally, inequality data is measured by the US Census Bureau. The metrics used for inequality include the Gini coefficient, which is a statistical measure of income dispersion, and the 90/10 and 50/10 ratios. The ratios measure the difference in income from someone in the 90<sup>th</sup> or 50<sup>th</sup> percentile of the

income distribution, and an individual at the 10<sup>th</sup> percentile. The Gini coefficient is calculated as a ratio using a Lorenz curve. It ranges from 0, denoting perfect equality, to 1, denoting perfect inequality. The concept of measuring inequality statistically is more recent, so yearly data is only available from 1967 onwards.

Moving on to explanatory variables, non-military and military expenditures, as well as revenue, are taken from [usgovernmentspending.com](http://usgovernmentspending.com), which records yearly government expenditures and revenue. Historical data is available going back more than 100 years, so spending data will not be a limiting factor on the scope of the analysis. Both spending and revenue data is normalized as a percentage of GDP, which helps to make data from different time periods more directly comparable. The Federal Funds rate and M1 are monitored by the Federal Reserve. As before, the limitations of spending/revenue data mean that only yearly data can be used. Data is available on the FFR since the inception of the Federal Reserve, but data on M1 is only available since 1978. The FFR is represented as a percentage, while M1 is represented in terms 2010 dollars.

The summary statistics for both the independent and dependent variables can be seen in Table 1. The most interesting feature of the data in that table is the relative standard deviations of the independent and dependent variables. Whereas unemployment, the gini coefficient, and the income ratios all have small standard deviations relative to their means, the standard deviations for the dependent variables are much larger. Military spending and the FFR seem particularly volatile. This difference is partially due to the fact that the unemployment and inequality data exclude World War II, but there is a more fundamental cause as well. One of the main objectives of government policy is economic stability: the charter of the Federal Reserve requires it to attempt to keep inflation and unemployment low and steady, and government fiscal



policy is often directed towards a similar goal. As a result, government policy can be thought of as a “shock absorber”, compensating for fluctuations in economic conditions so that the effects on unemployment and inequality are mitigated. By examining the relative magnitudes of changes in government policy and economic indicators, we can get a general idea of what level of change is required to produce a desired effect.

**Table 1.** Summary Statistics

	Observations	Mean	Standard Deviation	Minimum	Maximum
A. Dependent Variables					
Real GDP	100	6,387.8	4,557.0	950.4	15,260.7
Unemployment	66	5.77%	1.64%	2.9%	9.7%
Gini	44	0.364	0.031	0.326	0.411
90/10 Ratio	44	4.431	0.636	3.43	5.41
50/10 Ratio	44	2.204	0.135	1.94	2.50
B. Independent Variables					
Spending (n)	100	17.96%	9.88%	−16.84%	31.39%
Spending (m)	100	7.40%	7.02%	0.86%	42.04%
Revenue	100	22.54%	9.42%	−9.42%	37.37%
FFR	100	3.33%	5.06%	−11.05%	19.66%
M1	38	1,059.0	578.2	287.2	2654.1

**Note** Real GDP is denominated in 2010 dollars. 90/10 and 50/10 ratios refer to the ratio of income for individuals at the 90<sup>th</sup> and 50<sup>th</sup> percentiles, respectively, to those at the 10<sup>th</sup> percentile. Spending (n) refers to non-military government spending. Spending (m) refers to military government spending. FFR refers to the Federal Funds Rate. Spending and revenue are both represented as a percentage of real GDP.

Before a regression can be specified, though, the issue of multicollinearity must be dealt with. Obviously, variables such as government spending, taxation, and interest rates are likely to be highly correlated with one another, which substantially reduces the significance of their coefficients within a regression equation. For instance, Table 2 displays the correlation matrix of GDP Growth with the dependent variables:



**Table 2.** GDP Correlation Matrix (1914-2014)

	<b>GDP Growth</b>	<b>Spending (n)</b>	<b>Spending (m)</b>	<b>Revenue</b>	<b>FFR</b>
<b>GDP Growth</b>	1.0000				
<b>Spending (n)</b>	-0.1219	1.0000			
<b>Spending (m)</b>	-0.0562	-0.6077	1.0000		
<b>Revenue</b>	-0.1732	0.8851	-0.3000	1.0000	
<b>FFR</b>	0.0827	-0.1150	0.2456	-0.0516	1.0000

As you can see from this table, correlation between quantities like non-military spending, military spending, and revenue are especially high, which can dramatically reduce the power of our tests. Multicollinearity is an even larger problem for unemployment, because unemployment data is only available from 1947 onwards and correlation between military and non-military spending increased substantially after World War II. In fact, the correlation is a whopping  $-0.9299$ :

**Table 3.** Unemployment Correlation Matrix (1947-2013)

	<b>Unemployment</b>	<b>Spending (n)</b>	<b>Spending (m)</b>	<b>Revenue</b>	<b>FFR</b>
<b>Unemployment</b>	1.0000				
<b>Spending (n)</b>	0.3533	1.0000			
<b>Spending (m)</b>	-0.3312	-0.9299	1.0000		
<b>Revenue</b>	-0.4061	0.5280	-0.4130	1.0000	
<b>FFR</b>	0.1045	0.0361	-0.1284	0.0195	1.0000

**Table 4.** Inequality Correlation Matrix (1967-2013)

	<b>Gini</b>	<b>Spending (n)</b>	<b>Spending (m)</b>	<b>Revenue</b>	<b>FFR</b>
<b>Gini</b>	1.0000				
<b>Spending (n)</b>	0.8365	1.0000			
<b>Spending (m)</b>	-0.7666	-0.9475	1.0000		
<b>Revenue</b>	-0.4814	0.6599	-0.5580	1.0000	
<b>FFR</b>	-0.6300	-0.3234	0.2561	-0.1554	1.0000

This problem can be solved by leaving one intercorrelated variable as it is, but sequentially defining each additional variable as the residual of its relationship with the previous variables, as follows:

$$G_n = G'_n$$

$$G_m = \varepsilon_t, \text{ where } \varepsilon_t = G'_m - \beta_1 G_n$$

$$T = \varepsilon_t, \text{ where } \varepsilon_t = T' - \beta_1 G_m - \beta_2 G_n$$

$$I = \varepsilon_t, \text{ where } \varepsilon_t = I' - \beta_1 G_m - \beta_2 G_n - \beta_3 T$$

In each of these equations,  $X'$  represents the raw values, and  $X$  represents the residuals. Each of the variables is defined by running a regression of that variable on all of the previous variables. Then, the residuals of that regression become the new variable. This setup guarantees that the correlation between the explanatory variables will be precisely zero, removing any potential multicollinearity effects. The lags of each of these variables will be added via a similar process. With all of the variables properly defined, the general form of the regression equations I will use is as follows, where  $y_t$  can represent GDP growth, unemployment, or inequality:

$$y_t = \alpha + \beta_1 \vec{G}_n + \beta_2 \vec{G}_m + \beta_3 \vec{T} + \beta_4 \vec{I} + \varepsilon_t$$

All three equations use the same factors because these four factors are the ones most directly in control of the government. The first factor,  $\vec{G}_n$ , is a vector that contains non-military spending as a percentage of GDP for the current time period as well as a number of previous periods. There is no clear theoretical guideline for the number of different lagged values of government spending to use, but basic logistics suggests that government spending in one sector of the economy could take a considerable amount of time to be fully felt by all other sectors. I have determined how many lagged values to use through stepwise regression procedures, which individually test each new term to see if it adds predictive power to the model or not. The second factor,  $\vec{G}_m$ , is a similar vector that contains military government spending as a percentage of GDP for its time periods. The time periods to include will be determined by the same method. The third factor,  $\vec{T}$ , is a vector of tax rates. These rates will be determined by taking total

government revenue as a percentage of GDP. The main purpose of this explanatory variable is to control for the potentially different effects of tax-financed versus deficit-financed government spending. I will also run the regression using data for marginal tax rates, in order to test whether they provide better explanatory power. Finally, the fourth factor,  $\vec{I}$ , is a vector that controls for monetary policy. There are a number of different metrics to use to control for the effects of monetary policy, so I have run the regression multiple times with different metrics: interest rates, as represented by the Federal Funds Rate, and the money supply, as represented by M1. The purpose of this vector is to control the impact of monetary policy on the studied variables.

## VI. GDP Growth

Two separate regressions were run for the GDP Growth analysis – one using the Federal Funds Rate to model monetary policy, and one using M1. The results of these regressions are displayed in Table 5 and Table 6, respectively:

**Table 5.** OLS GDP Growth Regression (with FFR)

Growth	Coefficient	Std. Error	<i>t</i>	<i>P</i> >   <i>t</i>
Spending (n)	−0.112	0.039	−2.84	0.006
Spending (n) lag 1	0.790	0.113	6.97	0.000
Spending (m)	−0.259	0.070	−3.73	0.000
Spending (m) lag 1	2.243	0.281	7.98	0.000
Revenue	−0.120	0.116	−1.03	0.307
Revenue lag 1	−3.851	0.318	−12.12	0.000
FFR	19.082	7.892	2.42	0.018
FFR lag 1	−123.426	10.482	−11.78	0.000
Constant	5.213	0.808	6.45	0.000
	Observations	F-Statistic	<i>R</i> <sup>2</sup>	Root MSE
Overall	99	53.28	0.826	3.843

**Note** This comprises values from 1914 to 2014



**Table 6.** OLS GDP Growth Regression (with M1)

Growth	Coefficient	Std. Error	<i>t</i>	<i>P</i> >   <i>t</i>
Spending (n)	0.163	0.185	0.88	0.386
Spending (n) lag 1	−1.738	1.048	−1.66	0.108
Spending (m)	−2.093	0.865	−2.42	0.022
Spending (m) lag 1	2.389	1.277	1.87	0.072
Revenue	1.097	0.549	2.00	0.055
Revenue lag 1	−0.986	0.371	−2.66	0.013
M1	0.0036	0.0015	2.32	0.028
M1 lag 1	0.0057	0.0061	0.92	0.363
Constant	2.820	4.643	0.61	0.549
	Observations	F-Statistic	<i>R</i> <sup>2</sup>	Root MSE
Overall	37	8.60	0.711	1.870

**Note** This comprises values from 1975 to 2013

The main difference between these two regressions is the level of significance. Due to the fact that the M1 statistic has only been in use since 1975, using M1 as a metric for monetary policy severely circumscribes the available dataset. As a result, only 3 of the 8 variables in the second regression are statistically significant, whereas 7 of the 8 variables in the first regression are significant. The coefficients on government military and non-military spending are also significantly different. Given these limitations, the statistic of choice will be the Federal Funds Rate, which is continuously available since 1914.

The next step is to test whether this model specification is valid. To do this, we must first consider the potential ways in which a model might err from the true relationship between variables. The first and most obvious problem would be if the relationship between the variables is nonlinear. If that were the case, then it might still be possible to fit a line of best fit to the data, but it would be useless for prediction in the future. To test for this, I ran a Ramsey RESET test. Essentially, this tests whether any polynomial combination of the independent variables has power in explaining the response variable. In this analysis, the F-statistic was  $F(3,87) =$

1.63;  $P(F) = 0.1877$ . We therefore fail to reject the null hypothesis that the model is properly specified, and that the relationship between the variables is linear.

The next way that a model could fail is if it neglected to account for one or more significant sources of variation in its estimation. In this case, it might still be possible to get a statistically significant result, but it would be less than useful in the real world. There are several different tests for this, but the most powerful test that is available is the Breusch-Godfrey test, which looks for autocorrelation among the residuals without making assumptions about what form that autocorrelation might take. The results of this test for lags of 1 through 5 are displayed in Table 7 below:

**Table 7.** Breusch-Godfrey Test

Lags	Chi-Squared	Degrees of Freedom	Probability
1	1.286	1	0.2567
2	2.064	2	0.3564
3	2.803	3	0.4230
4	3.214	4	0.5226
5	3.223	5	0.6656

As required, none of the tests are statistically significant, so this test has failed to find evidence of autocorrelation among the residuals.

The final source of error for a statistical model is the assumption of homoscedasticity – that the variance of the underlying phenomenon remains the same over time. If this does not hold, then the model will be less accurate for out-of-sample predictions than otherwise assumed. Fortunately, this test statistic had  $\chi^2 = 0.00$ ,  $P(\chi^2) = 0.974$ , so we once again fail to reject the null hypothesis that the model is a good fit for the data. Given the results for these three statistical tests, we can be reasonably certain that this model is robust and accurate.

The preliminary results for this model do not contradict the hypothesis that increased government spending promotes GDP growth. As expected, there is a positive relationship

between government spending, both military and non-military, and GDP growth in the subsequent time period. Similarly, government revenue and the federal funds rate have a negative relationship with subsequent GDP growth. The relationship of spending and the federal funds rate with GDP during the same period is the opposite of what we expect. However, the sum of the coefficients still gives the expected sign for the relationship. With the exception of the present value of revenue, all of these results are statistically significant, so the results of this regression are consistent with the notion that higher spending and lower tax rates increase GDP growth.

The magnitudes of these changes, however, are somewhat surprising. The data suggests that an increase in government non-military spending of one percentage point will lead to a 0.68% increase in the growth rate for the subsequent period, holding all else constant. However, an equal increase in military spending is anticipated to cause a 1.98% increase in the growth rate. Relative to the average growth rates of around 6% per year, this is a significant increase. Meanwhile, the impact of increased revenue is even greater, with a  $-3.97\%$  decline in the growth rate for a one percentage point increase in taxation. These results contradict the study by Atesoglu (2004), which indicated that non-military spending had a much larger effect on investment (3%) than military spending (0.5%). However, I am measuring growth rather than investment, and while the two are closely related, investment is only one component of growth. The FFR data is represented as a proportion rather than a percent, so the coefficient of  $-104$  indicates that a one point increase in the FFR yields a  $-1.04\%$  penalty to growth. Overall, this evidence indicates that, dollar for dollar, military spending tends to have a greater impact on GDP growth in the subsequent period.



## VII. Unemployment

Once multicollinearity was removed from the explanatory variables, unemployment was regressed on government spending, revenue, and interest rates. The regression is very similar to the regression for growth, which makes sense given the strong correlation between unemployment and economic growth. The results of the initial regression are displayed in Table 8:

**Table 8.** OLS Unemployment Regression

Unemployment	Coefficient	Std. Error	<i>t</i>	<i>P</i> >   <i>t</i>
Spending (n)	−0.114	0.040	−2.85	0.006
Spending (n) lag 1	−0.021	0.088	−0.24	0.812
Spending (m)	0.144	0.140	1.03	0.309
Spending (m) lag 1	−0.046	0.136	−0.34	0.738
Revenue	−0.467	0.059	−7.94	0.000
Revenue lag 1	0.181	0.112	1.62	0.110
FFR	6.559	4.175	1.57	0.112
FFR lag 1	10.768	4.544	2.37	0.021
Constant	8.314	1.080	7.70	0.000
	Observations	F-Statistic	<i>R</i> <sup>2</sup>	Root MSE
Overall	66	17.19	0.707	0.950

**Note** This comprises values from 1947 to 2012

As with the regression for unemployment, the results of this analysis appear to show strong and significant relationships between unemployment and the explanatory variables (with the exception of military spending). However, the results of the robustness tests were less reassuring. The Ramsey RESET test returned an F-statistic of  $F(3,54) = 5.85$ ;  $P(F) = 0.0016$ , indicating a very high probability of a nonlinear relationship between the variables. Moreover, the results in the Breusch-Godfrey test, displayed in Table 9, showed a high degree of autocorrelation between the residuals. The only robustness test that this regression did not fail was the Breusch-Pagan test, with  $chi^2 = 0.02$ ;  $P(chi^2) = 0.883$ .

**Table 9.** Breusch-Godfrey Test

Lags	Chi-Squared	Degrees of Freedom	Probability
1	20.942	1	0.000
2	20.958	2	0.000
3	21.348	3	0.000
4	21.348	4	0.000
5	21.819	5	0.000

Clearly, the ordinary least squares method of linear regression is not a valid method of analyzing this data. Instead, a better model is the Prais-Winsten AR(1) Regression. This regression is specifically designed to remove serial autocorrelation between residuals, which corrects the errors delineated above. Although this regression technique has less power, it is far more robust and can give useful information even when OLS regression fails to do so. The results of the revised regression are displayed in Table 10:

**Table 10.** Revised Prais-Winsten AR(1) Regression

Unemployment	Coefficient	Std. Error	<i>t</i>	<i>P</i> >   <i>t</i>
Spending (n)	0.522	0.120	4.33	0.000
Spending (n) lag 1	0.053	0.065	0.81	0.419
Spending (m)	0.469	0.148	0.316	0.003
Spending (m) lag 1	−0.054	0.093	−0.58	0.563
Revenue	−0.812	0.108	−7.53	0.000
Revenue lag 1	−0.048	0.082	−0.59	0.561
FFR	1.167	3.875	0.30	0.764
FFR lag 1	−0.341	3.289	−0.10	0.918
Constant	−6.012	4.276	−1.41	0.165
	Observations	F-Statistic	<i>R</i> <sup>2</sup>	Root MSE
Overall	66	13.37	0.6524	0.680

The results of this regression indicate that non-military spending increases unemployment. The only statistically significant values are for present spending – both military and non-military – and revenue. The data suggests a positive relationship between spending and unemployment, and a negative one between revenue and unemployment. As with the present values for GDP growth, this may indicate that increased unemployment causes increased

spending and decreased revenue, rather than the other way around. In particular, government programs such as SNAP and unemployment insurance increase spending automatically when unemployment rises; meanwhile, as workers are laid off or unable to find full-time work, their income decreases, which reduces their tax rates and brings down government revenue as a percentage of GDP. However, there is little evidence from this data set that government spending or revenue can have a significant impact on future unemployment. In the future, it may be useful to look for additional data or experiment with more powerful regression techniques in order to get better results.

The magnitudes of the predicted effects for military and non-military spending do not have a statistically significant difference. In both cases, an increase in spending of 1% is correlated with an increase in unemployment of 0.5%. Revenue's impact is slightly larger, at  $-0.81\%$ . This reinforces the idea that the relative change in spending v. revenue is more important than the absolute amount. Increasing (or decreasing) both spending and taxation has a much smaller joint impact on employment. In both cases, though, the effect is extremely significant from an economic perspective. With average unemployment rates for the time period of 5.77%, even a change of a few percentage points can have a major effect, potentially defining the difference between a recession and an expansion.

## VIII. Inequality

Finally, inequality is regressed on the explanatory variables via a similar specification. However, in this case the independent variables are not lags 0 and 1, but the average of lags 3 –

7. Both theoretically and empirically, there is strong evidence that income inequality tends to



change more slowly in response to changes in taxation, spending, and monetary policy. These particular lags were chosen by regressing inequality (represented by the Gini Coefficient) on each explanatory variable one lag at a time and checking for significance. For all four cases, significant relationships were only found for values within this range of lags. I chose to use an average rather than regressing on all variables individually to avoid the potential for overfitting, which is particularly important given that there are only 44 observations available. The results of the preliminary regression are displayed in Table 11:

**Table 11.** OLS Inequality Regression (Gini Coefficient)

Inequality	Coefficient	Std. Error	<i>t</i>	<i>P</i> >   <i>t</i>
Spending (n) lag 3-7	0.00788	0.00072	10.98	0.000
Spending (m) lag 3-7	0.00683	0.00387	1.77	0.085
Revenue lag 3-7	-0.00164	0.00077	-2.14	0.039
FFR lag 3-7	-0.445	0.0597	-7.46	0.000
Constant	0.166	0.022	7.56	0.000
	Observations	F-Statistic	<i>R</i> <sup>2</sup>	Root MSE
Overall	44	187.77	0.9506	0.00735

**Note** This comprises values from 1967 to 2010

As usual, these results were then tested for robustness and potential sources of error. The Ramsey RESET test yielded an F-statistic of  $F(3,32) = 5.81$ ;  $P(F) = 0.0024$ , so there is a potential for miss-specification in this model. Additionally, the Breusch-Godfrey test concluded with high probability that there is autocorrelation among the residuals, as is displayed in Table 12. However, the Breusch-Pagan test yielded  $\chi^2 = 0.01$ ;  $P(\chi^2) = 0.9386$ , so it failed to reject the null hypothesis of homoscedasticity.

**Table 12.** Breusch-Godfrey Test

Lags	Chi-Squared	Degrees of Freedom	Probability
1	12.173	1	0.0005
2	15.495	2	0.0004
3	15.495	3	0.0014
4	16.191	4	0.0028
5	17.699	5	0.0033

Based on these results, a Prais-Winsten AR(1) regression was run for inequality data, and the results are displayed in Table 13. This is a good example of the importance of doing robustness checks. In the preliminary regression, it seemed that government revenue (taxation) was a statistically-significant predictor of income inequality, albeit just barely. However, running a more robust regression revealed that it was not significant – the only two significant predictors were non-military spending and the federal funds rate.

**Table 13.** Revised Prais-Winsten AR(1) Regression

Inequality	Coefficient	Std. Error	<i>t</i>	<i>P</i> >   <i>t</i>
Spending (n) lag 3-7	0.00788	0.00095	9.28	0.000
Spending (m) lag 3-7	0.00718	0.00496	1.45	0.156
Revenue lag 3-7	−0.00151	0.00120	−1.26	0.216
FFR lag 3-7	−0.412	0.0857	−4.80	0.000
Constant	0.166	0.0286	5.80	0.000
	Observations	F-Statistic	<i>R</i> <sup>2</sup>	Root MSE
Overall	44	142.98	0.9362	0.00622

The results of this analysis might seem somewhat surprising at first. Based on the results in Table 13, it seems that increased non-military government spending actually *increases* inequality, while higher federal funds rates decrease inequality. The point estimate for military spending, while statistically insignificant, is similar to that of non-military spending. However, all of the effects are quite small. The average Gini coefficient over the time period was 0.364, so an increase in spending of one percentage point will only change the Gini coefficient by 0.00788, or about 2%, increasing it to 0.372. Changes in the Federal Funds Rate are even less effective, with a one point increasing changing the Gini coefficient by just about 1.2%. This data would appear to indicate that income equality is largely exogenously determined. While government spending and monetary policy can have some effect, it would require truly gargantuan changes to make much of a difference to the Gini coefficient.

However, these results aren't as anomalous as they might seem at first. The key point is that this data measures *income* inequality, which does not include taxes or transfers. Given that government taxes and transfers tend to be progressive and aimed at reducing inequality, it is easy to see how the effect of these programs could make up for the small increase in income inequality caused by increased government spending. At the very least, the presence of two opposite effects suggests that the estimate for the magnitude of these variables is low. To properly assess the impact of government spending on inequality, it will be necessary to find data on income inequality after taxes and transfers, and then compare the results for both categories.

To explain the negative relationship between the federal funds rate and income inequality, it is necessary to examine the economic impacts of changes in that rate. While the federal funds rate ultimately impacts the entire economy by changing the baseline for all interest rates in the United States, its effects are not necessarily evenly felt. Increases in the federal funds rate cause interest rates paid on savings deposits to increase, but they tend to dampen business investment and stock market growth. Of the sectors mentioned, the stock market has by far the largest relative reaction to federal funds rate changes. This means that changes in the federal funds rate tend to disproportionately affect those with substantial stock market portfolios. As it turns out, those investors tend to be individuals with incomes in the upper quartile. Indeed, only 54% of Americans own any stock at all, and there is a strong correlation between income and stock ownership rates. As a result, the impact of the federal funds rate on the stock market tends to dominate its other effects, causing a negative relationship between the FFR and inequality.



## IX. Conclusion

Based on the results of this analysis, it appears that military spending is more effective at promoting growth than non-military spending, dollar for dollar. A sustained increase in non-military spending of 1% of GDP is correlated with a 0.68% increase in GDP growth, while a sustained increase in military spending of the same amount is correlated with a 1.98% increase in GDP growth. This is a somewhat surprising result, given the initial hypothesis that non-military spending would be more efficacious at promoting growth. However, there are some potential explanations. Non-military spending includes investments in infrastructure, but it also includes direct transfers like Social Security and Medicare. Military spending, on the other hand, is primarily composed of investments in new technology, weapons systems, or training. As a result, it has a stronger impact on growth.

The results for unemployment and inequality, on the other hand, showed little difference between military and non-military spending. For unemployment, an increase in spending (military or non-military) of 1% of GDP was correlated with approximately a 0.5% increase in the unemployment rate. For inequality, non-military spending was statistically significant while military spending was not, but both had similar point estimates. An increase in spending by 1% of GDP was correlated with approximately a 0.0075 increase in the Gini Coefficient, which measures income dispersion. The sign of this effect is the opposite of what was expected, but this anomaly could be explained by the fact that the Gini Coefficient only considers income before taxes and transfers. It also doesn't take into account government-provided services like free public education or healthcare.

In the future, this analysis could be expanded in a number of directions. Limitations of the data set made it difficult to determine the true impact of government spending on inequality, making it difficult to fully interpret the results. Further analysis could focus on quantifying the benefits – in terms of effective income – to each citizen of government transfers, services, etc. Then, this data could be combined with income data to get a clearer measure of real inequality. In such a framework, it is likely that government spending will have a larger, and potentially opposite, impact on inequality. Another useful exploration would be to compare this to an identical analysis conducted on a country with much higher base rates of government spending as a percentage of GDP. US government spending stayed within a relatively narrow band for much of the period in question, so it's difficult to determine if the relationships found here would continue to hold as spending and revenue increase.

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