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The Defense-Growth Relationship: An Economic Investigation into Post-Soviet States

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The Defense-Growth Relationship: An Economic Investigation into Post-Soviet States*

Bruce D. McDonald III and Robert J. Eger III

Abstract

An important question stemming from the collapse of the Soviet Union is how defense spending has influenced the economic performance of the 15 member states since their establishment as market economies. This study furthers the understanding of the relationship between defense spending and economic growth using data from the states of the former Soviet Union from 1992 to 2007. A nonlinear production function was used for direct effects, and models of investment and employment were employed for indirect effects. Contrary to expectations, the findings show that continued reliance on the defense sector in post-Soviet states has helped overall economic growth. Similarly, the growth effect of defense spending has remained nearly constant since the collapse of the Soviet Union.

KEYWORDS: military expenditures, economic growth, former Soviet Union

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On December 25, 1991, the Union of Soviet Socialist Republics (henceforth referred to as the Soviet Union) collapsed after a six-year economic and political decline. With governmental control handed to the president of Russia and the heads of other newly sovereign states, the post-Soviet republics were thrown into a whirlwind of turmoil and transition. Prior to collapse, the 15 member states had been reliant upon Moscow for guidance in determination and administration of their political and economic choices. As the states worked to implement their preferred economic systems, many market economists expected that the collapse of the Soviet administrative control system would improve economic growth and living standards by allowing the states to allocate their resources more efficiently. Certainly their transition into market economies has been rough, resulting in a drop of GDP by half and a reduction in the overall quality of life. Ultimately, with the disintegration of the Soviet Union and the movement for re-establishment, 15 new economies and militaries were formed; one nuclear power was transformed into four.

To date, the literature on the post-Soviet states has focused heavily on the establishment of the new states, their reallocation of labor, and their trends in capital accumulation (Izyumov and Vahaly 2008). The story of post-Soviet economic growth is not just one of economies in transition, but rather covers a shift in national focus and sectors. During the Cold War, the Soviet Union provided security for each of its member states, routinely spending more than 15 percent of GDP on defense related projects (Stockholm International Peace Research Institute 2009). 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 under other circumstances. In the years since, the newly formed states have been forced to reinvent themselves. This reinvention includes not only the development of political and economic systems, but also the adoption of national defense strategies for radically changing militaries. As shown in Figure 1, the post-collapse establishment of national

---

1The 15 states of the former Soviet Union are Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

2 Prior to its collapse, the Soviet Union was a singular nuclear power. After collapse, control over the nuclear arsenal was divided among Belarus, Kazakhstan, Russia, and Ukraine. Ownership of the nuclear arsenal was later returned to Russia, with completion of the handover in 1996.

militaries represented a shift in defense strategies and policies. The combined defense spending of post-Soviet states was significantly less than that of the Soviet Union only a few years earlier. While the literature has discussed the issue of growth in the post-Soviet states, what has not been addressed is the question of how the defense sector has influenced the economic performance of the states.

The issue of how a nation’s defense spending affects its overall economic performance (referred to here as the defense-growth relationship) has been an area of contention and concern to both academics and politicians for some time (Benoit 1973; Heo 1998; Mintz and Huang 1990; Russett 1969). Despite attention given to the defense-growth relationship, the literature has not been so clear-cut as to suggest a definitive transferable relationship to the post-Soviet states without further study. For example, proponents of the defense-growth relationship have argued that defense spending spawns investment in new technologies, provides a stabilizing effect conducive to market operation, and reduces unemployment due to the resource-intensive nature of the military (Atesoglu and Mueller 1990; Frederiksen and McNab 2001; Mueller and Atesoglu 1993). Alternatively,
opponents have argued that defense spending hinders growth by crowding out investment and reducing the resources available for social welfare programs (Chan 1985; DeGrasse 1983; Heo and Eger 2005).

The contribution of this study is two-fold. First, by studying the defense-growth relationship in the post-Soviet states, we can gain a better understanding of their economic development and the effects that further demilitarization would have on their prosperity. Second, it brings much needed clarification of the defense-growth relationship. While the literature shows no consensus on the relationship between defense spending and economic growth, the experience of the post-Soviet states offers the potential to explore that relationship in countries that are undergoing a rapid and dramatic transition from highly militarized member republics to independent states. Using new data of international financial statistics and defense spending estimates, this study seeks to expand understanding of both the nature of economic growth in post-Soviet states and the impact and implications that changes in defense transition had on that growth.

This study consists of four sections. Following this introduction, Section I provides a review of the existing literature, focusing on the development of the needed links between defense spending and economic growth. Section II develops and explains the methodology used to measure the direct and indirect economic impact of defense spending in the post-Soviet states. Findings of the study are provided in Section III. Finally, Section IV provides an analysis of the findings and a series of closing remarks explaining the strengths and weaknesses of the research.

SECTION I: LITERATURE AND THEORY

The relationship between defense spending and the economic growth of a nation have been studied extensively, beginning with the seminal work of Beniot (1973, 1978) and others (see also Aizenman and Glick 2006; Mintz and Huang 1990; Pieroni and d'Agostino 2008; Russett 1969; Ward and Davis 1992). However, researchers have failed to reach a consensus as to whether a relationship does exist and if that relationship would be positive or negative. As noted by Chan (1987), the inconsistent results we see in the literature only serve to ensure that a study of the existing field is “as likely to bewilder as it is to enlighten” (p. 8).

Direct Effects of Defense Spending

There are three perspectives regarding the economic effects of defense expenditures on a nation. First is the perspective that defense expenditures produce a positive effect on economic growth (Atesoglu 2002; Chan 1985; Cuaresma and Reitschuler 2004; Frederiksen and Looney 1983; Mueller and
Atesoglu 1993). As an early proponent of the defense-growth paradigm, Benoit (1973, 1978) believed in the association between military armament and economic development. By looking at the relationship through a correlation of less developed countries, Benoit argues that it is possible to stimulate the economy by spending money on defense related projects. This stimulation comes in a variety of forms, such as providing an increase in purchasing power or aggregate demand or through positive externalities such as human capital formation and security spillover.

According to Benoit (1973, 1978), the defense sector not only subsidizes the education of its forces, but also provides vocational and technical training that can be used in the private sector after the completion of service. Additionally, defense programs often have tangible benefits that can also have a public use and benefit (Gold 1990). Included in the public use category are defense programs that build airports, bridges, and roads which the private sector would otherwise have to construct (Benoit 1973; Bernaur et al. 2009). Benoit, however, has not been alone in his belief in a positive association, as other research projects have found evidence to support the idea of defense spending providing a positive influence on economic growth (Atesoglu and Mueller 1990; Atesoglu 2002; Frederiksen and Looney 1983; Frederiksen and McNab 2001; Mueller and Atesoglu 1993; Weede 1986).

In one study, Mintz and Stevenson (1995) found that regardless of the specification of the model used, defense spending had a positive effect on growth in only 10 percent of cases. For the remaining instances, the literature has suggested a second perspective that defense expenditures reduce a nation’s level of economic growth (Heo and Eger 2005; Knight et al. 1996; Mintz and Huang 1990). Central to this perspective is the contention that defense expenditures produce a crowding-out effect on investment, referred to as a “guns versus butter” tradeoff, whereby an increase in defense expenditures produces an increase in tax burden (Chan 1987; Heo Forthcoming). That is to say that expenditures must be financed by raising current taxes or borrowing against future taxes by issuing new government debt (Chan 1985; DeGrasse 1983; Ward and Davis 1992). According to Knight et al. (1996), this crowding-out will lower the return on fixed capital by reducing the investment available to finance capital formation in the private economy. Similarly, Russett (1969) argues that defense expenditures reduce investment and private consumption. Defense expenditures may also effect growth through its influence upon the efficiency of resource allocation (Knight et al. 1996). While the private sector is ruled by a market economy, the defense sector does not face the same processes. Demonstrating the inefficiency of resource allocation, Ward and Davis (1992) show that defense expenditures can limit growth by moving resources away from the public sector, which maintains a
higher rate of productivity than either the defense or nondefense sectors (see also Cappelen et al. 1984; DeGrasse 1983; Mintz and Huang 1990; Ward et al. 1995). A third, and last, perspective is that defense expenditures have no significant effect on economic growth (Chowdhury 1991; Heo 2000; Ohanian 1997). One reason for the lack of significance is that defense expenditures, when considered on a per capita basis, are not large enough to have any meaningful influence (Gerace 2002). The defense-growth paradigm is often seen as a global model, but the relationship may vary depending on the nation and region (Gangopadhyay and Elkanj 2009; Sevastianova 2009). Ohanian (1997) argues that the effect of defense expenditures can vary either positively or negatively, but that the relationship was determined by means of government financing rather than total budgetary expenditures, an idea supported by Carroll (2006) and Heo and Bohte (2008). In addition, Biswas and Ram (1986) posit that defense expenditures can have mixed effects on economic growth, attributing the lack of consistency significance and direction to variation in defense budgets and programs over time.

Chan (1985) also points out that “military expenditures tend to be more import-demanding (in developing countries) than other forms of public spending, and, thus, again contribute more to their unfavorable balance of payments” (p. 418). Long term, the unfavorable balance of payments would produce high rates of inflation, reducing the competitiveness of the nation in international trade. A last argument behind an insignificant effect is that the impact can vary from one nation to the next, depending upon the nation’s reliance of the defense sector for employment. Within this perspective, countries with a large defense sector and a small private sector would have a positive association while those with a small defense sector and a large private sector would have a negative association (Pieroni and d’Agostino 2008).

Due to the mixed results displayed in the literature of the defense-growth paradigm, we are presented with a choice of perspective on which to base our analysis. Given that each perspectives outlined above is theoretically based, we can assume that the relationship is an empirical issue rather than a theoretical one. Stemming from the lack of consensus in the literature and the idea that the relationship may be empirically based, we anticipate that a relationship between the defense spending and economic growth in post-Soviet states exists, but the size and direction is yet to be determined. From this, we hypothesize the following:

**Hypothesis 1:** Defense spending has an effect on economic growth.
Indirect Effects of Defense Spending

Although much of the literature on the defense-growth relationship has focused on direct influence, the real effects of defense spending on economic growth may not be direct (Heo Forthcoming). As Chan (1985), Deger (1986), and Mintz and Huang (1990, 1991) have all noted, the real effects of the defense-growth relationship may be through indirect channels, such as investment and employment. As such, any attempt to understand the defense-growth relationship must also address indirect channels.

Investment is largely considered a key element in economic growth (Jones 2002), with future production dependent upon resource capacity. A number of studies have shown that defense spending crowds out investment throughout the world (DeGrasse 1983; Laopodis 2001; Scott 2001). The crowding out effect of defense spending on investment can be explained by two trade-offs.

The first trade-off is from competition for available economic output. Within developing nations, we assume the availability of only a limited number of resources. Since a country’s ability to provide capital for future ventures is dependent upon its savings and investments, an increase in defense spending would create competition for available capital (Heo 1998). As defense spending increases, the capital available for private investment declines, forcing the choice between investing in either national defense or the private sector. Given this restriction, trade-offs are expected to occur between maximizing individual utility, putting the money into another area that can be more productive, and funding new or existing defense programs. Given the size of the post-Soviet defense sector and the financial constraints witnessed by the post-Soviet states, an increase in defense spending can be expected to crowd out capital investment as resources were moved to cover the cost of the military.

A trade-off may also occur as a result of how the expenditures are financed. To finance any government program, initial investments are required, which can only be financed by creating new taxes, increasing the budgetary deficit (Chan 1985; DeGrasse 1983; Ward and Davis 1992). Although defense spending has historically been financed by new taxes, both means of financing are expected to lower the after-tax return on capital and reduce the flow of savings available to finance capital formation (Carroll 2006). If an increased tax burden is used, the higher income taxes will reduce the after-tax return on private investment. Not only will individuals have less money to save and invest, but it will also affect their incentive to invest. The result is punctuated declines in the level of private capital available for investment. Alternatively, if defense spending is financed by issuing new debt, interest rates are likely to rise. The higher interest rates would depress investment further, restricting the resources available for future investments as competition for the limited resources is heightened. Based
on the above discussion of a crowding-out effect, we hypothesize the following within the post-Soviet experience:

**Hypothesis 2:** Defense spending has a negative effect on investment.

The impact of defense spending on employment remains a point of contention because while the defense sector can reduce growth and investment, it also provides job opportunities and job security. Benoit’s (1973) initial theory on the defense-growth relationship would suggest that defense spending has a positive influence on the level of employment, due to labor demands associated with a military buildup. As defense spending increases, the defense sector is expected to expand equally. To meet labor demands resulting from the expansion, the labor sector should see growth as it transitions people from unemployment to employment. Furthermore, the expansion of defense programs not only provides jobs directly to active duty soldiers, but firms producing goods for military consumption create indirect employment for civilians.

Alternatively, DeGrasse (1983) argues that due to the relatively high cost of defense programs, government expenditures could be used more effectively for job creation outside the defense sector as private goods and services provide a greater return on job creation. One cause for this inefficiency may be the level of technical sophistication required by the defense sector as compared to private industry. For example, military communication systems and aircraft maintenance and flight require specialized skill sets, forcing militaries to employ well-trained staff and fewer blue-collar laborers. Because professional and technical laborers typically have a lower unemployment rate than other occupational categories, the long run contribution of defense spending to employment is likely to be small (Heo and Eger 2005). Thus, while defense spending might increase employment, it will fail to significantly reduce the level of unemployment due to the negative economic effect of defense spending (Henderson 1998). Given the complex relationship between defense spending and employment, Chan (1987) posits that defense spending creates structural unemployment in the long run by creating a weaker consumer demand, decline in international competitiveness, and a slower rate of economic growth.

Although employment within the post-Soviet defense sectors remained high throughout the 1990s, the armed forces of the post-Soviet states have been faced with reduction to comply with the provisions of the Conventional Armed Forces Europe treaty (Stanley 1997). Although defense spending has remained

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4 The Treaty on Conventional Armed Forces Europe (CFE) was signed in November, 1990 and effective as of July, 1992 in order to establish parity, transparency, and stability in the balance of armed forces in Europe stretching from the Atlantic Ocean to the Ural Mountains. A key goal of the treaty was to deal with force reduction in a mutually balanced process by capping the maximum
high in many of the states, as they established and rebuilt their own defense sectors, the mandatory force reductions from Cold War levels have led to increased spending to improve efficiency by cutting redundancies inherent in the Soviet system. Thus, in looking at the relationship between defense spending and employment, we anticipate a negative association. Accordingly, we hypothesize the following:

Hypothesis 3: Defense spending has a negative effect on employment.

SECTION II: MODEL, METHODOLOGY, AND DATA

Investigating the defense-growth relationship in a post-Soviet context, we acknowledge that defense spending can have both a direct and an indirect impact on the economic growth of post-Soviet states. To capture each of these effects, we focus on three measures: economic growth, investment, and employment.

Modeling the Effect of Defense Spending on Economic Growth

Despite the interest of researchers in understanding the defense-growth relationship, the literature has failed to produce a dominant theoretical framework and model for addressing the relationship (Mintz and Stevenson 1995). As a result, in testing the hypothesis of an effect on economic growth (hypothesis 1), we are faced with the lack of a consistent model on which to base our research. Observing this difficulty, Deger (1986) argues, “economic theory should dictate what variables we should include in…the growth equation” (p. 260). This paper adopts a Feder-Ram based model that is grounded in a neoclassical production function, commonly used as a tool for measuring the impact of defense spending on economic growth (Atesoglu and Mueller 1990; Heo 1998; Heo and Eger 2005; Mintz and Huang 1990; Mintz and Stevenson 1995; Sandler and Hartley 1995). In determining the defense-growth relationship, this approach is generally preferred due to its derivation from a consistent and solid theoretical structure. This approach is also preferable given the previous success of neoclassical models in explaining economic growth within transition economies (see Lucas 2000; Crafts and Kaiser 2004) and the defense-growth relationship in developing economies (Heo 1998; Mintz and Stevenson 1995).

Based on Denison’s (1985) sources-of-growth model, a Feder-Ram approach seeks to explain aggregate growth with changes in labor and capital.
Earlier research placed the economic impact of defense spending into a two-sector production function of defense and non-defense, owing to the assumption that the impact of the defense sector is fundamentally different than that of the rest of the economy (Mueller and Atesoglu 1993). A two-sector approach, however, presents some problems in that the non-defense sector is seen as a combination of both the private sector and the non-defense governmental sector. Ward and Davis (1992) furthered the use of a neoclassical production function by showing that the rates of productivity differ between the private sector and non-defense related government sector. The distinction of sectors provides theoretical reasoning for assuming that the economy consists of three sectors by separating the defense and the non-defense sectors from the rest of the economy (Heo 1998). Although Dunne et al. (2005) have criticized the Feder-Ram approach for having a simultaneity bias and multicollinearity issues, instead recommending an augmented Solow model, Heo (Forthcoming) has suggested that the results will be the same regardless of the model used.

Thus, we assume that the economy is composed of three sectors, each contributing to the national economic output. These sectors are governmental defense (represented as $D$), non-defense governmental (represented as $N$), and private sectors (represented as $P$). Within this function, both labor ($L$) and capital ($K$) represent inputs to each of the sectors. Due to the likelihood of externality effects on the defense and non-defense government sectors, the externalities are also included as inputs to the public sector (Mintz and Huang 1990). Thus, we can represent the sectors as:

\[ D = A(t)F(L_d, K_d) \]
\[ N = B(t)G(L_n, K_n) \]
\[ P = C(t)H(L_p, K_p, D, N) \]

such that subscripts denote the sector inputs for the defense sector, non-defense sector, and private sector, respectively. Using total inputs of labor, capital, technological change, and marginal productivity against other sectors, we develop the following equation [see Heo and DeRouen (1998) for a full derivation of the model]:

\[
\frac{dY}{Y} = \lambda + e^{zD} \psi_Y (dL / L) + e^{zN} \psi_K (I / Y) + [\pi_d (D / Y) + e^{zD} \psi_d]
\]
\[
(dD / D) + [\pi_n (N / Y) + e^{zD} \psi_n] (dN / N) + \lambda \pi_d (D / Y) + \lambda \pi_n (N / Y)
\]

whereas $dD/D$ represents the growth rate of defense spending, $dN/N$ represents the growth rate of non-defense spending, $dL/L$ represents the growth rate of labor,
D/Y is the defense share of GDP, and N/Y is the non-defense spending share of GDP. The effects of technological progress and change in productivity on economic growth are combined and represented as \( \pi_i \). Externality effects are represented as \( \psi_i \) and the technological factor is represented as \( e^{\lambda t} \).

The post-Soviet states are not viewed as technologically advanced societies, nor have they been responsible for the significant advancement of technological knowledge. It is these advancements that are typically accounted for in the technology factor \( e^{\lambda t} \). This factor is included in the model of this study; however, it is based on the adoption of technology after the collapse of the Soviet Union. Under Soviet control, member states were restricted from outside influence, including access to any technological advancement. After collapse, however, technological advancement would be expected to grow exponentially as part of either a learning curve or catch-up period and as regular progress. Thus, we understand \( e^{\lambda t} \) as a measure of technology adoption and growth of technological understanding.

Modeling the Effect of Defense Spending on Investment

Within the macroeconomic literature, investment is considered to be a crucial part of economic growth, based on the belief that an economy’s future product is dependent upon its available capacity. To test the economic effects of defense spending on investment, we follow the previous literature on the defense-growth relationship and adopt the model developed by Mintz and Huang (1990, 1991). As a modified version of the accelerator model originally proposed by Clark (1917) – as improved upon by Chenery (1952) and Koyck (1954) – the Mintz and Huang model of investment allows for segregation of the defense spending impact from other drivers of investment. As noted by Clark (1979), a flexible accelerator model is not only practically estimable, it also maintains statistical performance superiority over other investment specifications.

A flexible accelerator model starts with investment, \( I_t \), as a function of the economy’s previous output \( Y \), and its previous stock of capital \( K \), which is assumed to depreciate at a constant rate. The relationship is represented as follows:

\[
I_t = \sum_{i=0}^{\infty} \beta_i \Delta Y_{t-i} + dK_{t-i} \quad (3)
\]

Next, within the neoclassical approach, GDP is defined as the sum of an economy’s consumption \( C \), investment \( I \), total government expenditures \( G \), and net exports, which are equal to total exports \( EX \) minus imports \( IM \). This relationship can be demonstrated as:

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DOI: 10.2202/1554-8597.1191
Making the assumption that the private sector $P$ is comprised of consumption, investment, and net exports, we get:

$$Y = P + G$$

(5)

Disaggregating the government sector into defense expenditures $D$ and non-defense expenditures $N$, the above equation can be written as:

$$Y = P + D + N$$

(6)

Using the distributive law, the rate of change in $Y$ is equal to the sum of the rate of change for the private, defense, and non-defense sectors. That is,

$$\Delta Y = \Delta P + \Delta D + \Delta N$$

(7)

Substituting for the original accelerator model, we arrive at:

$$I_t = \sum_{i=0}^{\infty} \beta_1 \Delta P_{t-i} + \sum_{i=0}^{\infty} \beta_2 \Delta D_{t-i} + \sum_{i=0}^{\infty} \beta_3 \Delta N_{t-i} + dK_{t-1}$$

(8)

To transform this into a statistical model for estimation, we allow for a limited number of lagged coefficients for each variable. Next, we divide both sides by $Y$ to obtain the proportion of GDP invested by each sector. Not only does this produce more theoretically interesting results, but also reduces the likelihood of heteroscedasticity within the estimations, since the level of investment error variance tends to rise proportionally with economy size. Last, adding constant and error terms for ease of estimation, the resulting model becomes:

$$\frac{I_t}{Y_t} = \alpha + \sum_{i=0}^{n} \beta_1 \frac{\Delta P_{t-i}}{Y_t} + \sum_{i=0}^{n} \beta_2 \frac{\Delta D_{t-i}}{Y_t} + \sum_{i=0}^{n} \beta_3 \frac{\Delta N_{t-i}}{Y_t} + \beta_4 \frac{dK_{t-1}}{Y_t} + \varepsilon$$

(9)

Modeling the Effect of Defense Spending on Employment

In testing the impact of defense spending on unemployment, we are presented with the issue of modeling the relationship. Not only is the relationship between defense spending and employment controversial, the best means of modeling the relationship has not been agreed upon (Dunne and Smith 1990; Heo and Eger...
2005). To test for impact, this paper follows the work of Dunne and Smith (1990), Hooker and Knetter (1994), and Heo and Eger (2005), which assumes that nations maintain an equilibrium in labor, driven by market conditions and various regulations. A change in a nation’s defense spending would be expected to shock their equilibrium and influence levels of unemployment. To capture this equilibrium, we make use of a simple regression model with unemployment estimates regressed on defense and non-defense related spending. Added to this model is a lag on unemployment to account for the opportunity cost associated with the change, as insisted by Chan (1987). Within the post-Soviet experience, a lag is also appropriate to capture the effect of the time difference between defense production, the size of defense employment, and needs of industry laborers. The model may therefore be specified as:

\[
\text{Unemployment}_t = \alpha + \beta_1 \text{Unemployment}_{t-1} + \sum_{i=0}^{N} \beta_2 \text{Defense Spending}_{t-i} + \sum_{i=0}^{N} \beta_3 \text{Nondefense Spending}_{t-i} + \epsilon
\] (10)

Data

In this study, data from the post-Soviet states were collected for the years 1992 to 2007\(^5\) and are expressed in constant 2005 U.S. dollars. Although consistent and reliable data are not readily available for all countries in all years, attempts were made to use data from authoritative sources. Due to limitations in data availability, however, Turkmenistan was excluded from data collection and analysis.

Data on defense spending were obtained from the Stockholm International Peace Research Institute (SIPRI)’s *World Armaments and Disarmament Yearbook*. Although the use of SIPRI data on defense spending has been questioned regarding accuracy and comparability across countries (Brzoska 1981; Mintz and Stevenson 1995), the criteria used by SIPRI to reach their estimates are based on the convergence of data for a given country from government budgetary documents and a variety of major sources (for further information regarding SIPRI’s method of expenditure estimation, see Stockholm International Peace Research Institute 2009). We do not ignore, however, problems of data quality. Rather, given the lack of definitive data on spending, we believe SIPRI’s

\(^5\) The time series of our data is limited to sixteen years. Ideally we would like a time series that exceeds twenty years to address the averaging of effects over time. However, the data used in this study present us with a reasonable time series given the graphical presentation in Figure 1. We would like to make the reader aware of this limitation and the potential effect it may have on the future spending effects within the states investigated.
convergence methodology produces the most accurate estimates available for the post-Soviet states.

Table 1. Statistical Summary of Variables, (thousands)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>53,495,000</td>
<td>10,669,000</td>
<td>976,000</td>
<td>121,429,000</td>
</tr>
<tr>
<td>Defense Spending</td>
<td>2,045,000</td>
<td>458,000</td>
<td>8,300</td>
<td>37,569,000</td>
</tr>
<tr>
<td>Non-Defense Spending</td>
<td>7,450,000</td>
<td>1,478,000</td>
<td>1,200</td>
<td>175,791,000</td>
</tr>
<tr>
<td>Private Sector</td>
<td>44,764,000</td>
<td>8595,000</td>
<td>862,000</td>
<td>1,004,683,000</td>
</tr>
<tr>
<td>Capital Stock</td>
<td>10,990,000</td>
<td>2,077,000</td>
<td>29,000</td>
<td>255,447,000</td>
</tr>
<tr>
<td>Investment</td>
<td>10,914,000</td>
<td>2,406,000</td>
<td>19,000</td>
<td>28,774,000</td>
</tr>
<tr>
<td>Unemployment</td>
<td>498</td>
<td>1,394</td>
<td>2.9</td>
<td>9,100</td>
</tr>
</tbody>
</table>

Finance related data are expressed in dollars.

While SIPRI data are preferable, estimates were not available for all states in all years. When SIPRI data are not available, defense spending estimates from the World Bank were substituted. As a supplement to SIPRI data, World Bank estimates are preferable over other sources for two reasons. First, by using a definition of defense spending identical to that of SIPRI, World Bank estimates are able to limit the introduction or exclusion of expenditures not captured by SIPRI. Second, given SIPRI’s convergence process across major sources of data for estimating a state’s defense spending, World Bank estimates are considered within SIPRI data. In comparison of SIPRI and World Bank data, both exhibited similar trends for the states involved in this analysis, giving us some confidence that the use of SIPRI data for all years, if it were available, would likely lead to results similar to our own.

Regarding other data used in this study, data on total government consumption, the size of the labor sector, and the number of unemployed persons are from the Common Database of the United Nation’s Statistics Division. Estimates of GDP and capital formation are obtained from the World Bank’s World Development Indicators Dataset. Last, data on gross private direct investments are from the International Monetary Fund’s World Economic Outlook Databases. To account for non-defense related government expenditures, we subtracted defense spending from the total government consumption. Similarly, to account for the private sector, we subtracted total government consumption from GDP. Summary statistics of key variables are given in Table 1.

Methodology

In estimating our models, we employ a pooled cross-sectional time series design that can explain variation in economic growth, both over time and across post-Soviet states. This approach allows for the explanation of co-variation between the economy and the independent variables that are predicted to impact economic growth. Since the direct model of economic growth includes exponents, a nonlinear least squares regression method is adopted. Estimates of the indirect models employ an ordinary least squares regression method. With specification of a pooled approach, the assumption is that the coefficients are the same for each state in the analysis. The adoption of a random effects model would also assume that the error term for each state is uncorrelated with the other states in the panel. A fixed effects model, however, focuses on the differences within, rather than between, countries. To ensure best estimation, we employ Hausman’s test to determine whether a random or fixed effects model is more appropriate. Given the results of this test, and the fact that government structures and defense programs vary across the post-Soviet states, the fixed effects for year and country are accounted for. To estimate our model of employment, we employ the natural logs of each variable to capture the rate of change. The natural log was not used in our models of economic growth and investment as both models account for the rates of change as currently derived.

In estimating our models, we must also address the proper length of the time lags, as the impact of defense spending on economic growth tends to include a delayed effect (Mintz and Huang 1990). Traditionally, an objective information criterion would be used to determine the best lag structure. An increased lag structure would provide greater explanation, but it would also suffer from a severe reduction in the available observations due to the limitation of available years for data collection. To maximize the use of the available data and still account for a delayed effect, the lag structure adopted for this paper has been set to $t-2$. Although this can be seen as a weakness in that the influence may take longer than two years, findings in the empirical literature on the defense-growth relationship have suggested that a delayed impact should be visible early on, with later years only repeating the influence at a depreciated rate (Heo and Eger 2005; Mintz and Huang 1991). Thus, while we are not able to capture the full long-term effect of the defense sector, we are able to capture effects that point in the direction of the long-term impacts.

We also test for autocorrelation within the findings on the basis that the analysis is longitudinal. According to Sayrs (1989), “[t]he appropriate statistic for a pool must recognize the uniqueness of each cross-section…that estimates an average autoregression given the cross-sections” (p.19). That is, to estimate a Durbin-Watson statistic in a pooled approach, the statistic is obtained for each
cross-section and then averaged together (for additional details, see Sayrs 1989). Using the Durbin-Watson statistic, the estimations of the investment model were tested for serial correlation. Given the unique nature of the employment and economic growth models, however, testing for autocorrelation in each of these estimations required additional steps. First, due to the inclusion of a lagged endogenous variable included on the right hand side of the employment model, a Durbin-Watson statistic could be close to 2, even if estimation includes serial correlation (see Durbin 1960). To overcome this difficulty, a Durbin’s h statistic was adopted (for additional details, see Pindyck and Rubinfeld 1998). Second, the Durbin-Watson statistic is also not appropriate for the economic growth model, given the linear assumptions of the statistic (see White 1992) and the nonlinear nature of the model. To overcome this problem, we adopted the approximate nonlinear Durbin-Watson statistic. Based on the Durbin-Watson statistics, none of the models exhibited serial correlation.

For the potential causality problem between economic growth and defense spending, we employ the panel Granger non-causality test developed by Hurlin and Venet (2001) and Hurlin (2007). This approach follows a standard Granger causality test by retrieving the Granger results for each state in the study and then obtaining an averaged result. The results indicate that there is no statistically significant effect of economic growth on defense spending. An overview of the results of the Granger non-causality test for this study is provided in Table 2.

### Section III: Findings

The results of the estimation of the direct model are reported in Table 3. Interpreting the model, a significant and positive coefficient suggests that the defense sector generates positive externalities in the private sector of the post-Soviet states. Based on the coefficients, it would appear that defense spending both promotes growth, with a positive coefficient on the productivity of the defense sector (\(\pi_d\)), and hinders it, with a negative coefficient on the externality
The dual direction of these coefficients is in contradiction to the theory of the defense-growth relationship, which had previously hypothesized a negative relationship. In order to fully understand the impact of defense spending on economic growth, however, the real effects must be established based on the direct model of economic growth.

To obtain the real effects of defense and non-defense governmental spending, further calculation is required. The coefficients for the elasticity of total economic output, with respect to defense and non-defense government spending, are \((\pi_d(D/Y) + e^{t\psi_d})\) and \((\pi_n(n/Y) + e^{t\psi_n})\). Therefore, the real effects can be calculated using the estimates of \(\lambda, \pi,\) and \(\psi,\) the mean value of the defense and non-defense shares of GDP, and the mean value of the median year of the data \((t = 2000).\) Coefficients for the ratios of defense and non-defense to GDP \((\lambda\pi_d\) and \(\lambda\pi_n)\) can also be calculated using the estimate for \(\lambda, \pi_d,\) and \(\pi_n.\) A summary of the additional calculations has also been provided in Table 3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model: Economic Growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent Variable: GDP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\lambda) est.</td>
<td>-0.3545</td>
<td>-3.03***</td>
</tr>
<tr>
<td>(\psi_l)</td>
<td>0.0764</td>
<td>0.92</td>
</tr>
<tr>
<td>(\psi_k)</td>
<td>0.2969</td>
<td>2.49***</td>
</tr>
<tr>
<td>(\pi_d)</td>
<td>4.0031</td>
<td>2.89***</td>
</tr>
<tr>
<td>(\psi_d)</td>
<td>-0.0084</td>
<td>-0.29</td>
</tr>
<tr>
<td>(\pi_n)</td>
<td>1.6848</td>
<td>7.18***</td>
</tr>
<tr>
<td>(\psi_n)</td>
<td>0.0358</td>
<td>2.34***</td>
</tr>
<tr>
<td>Fixed effects for year and country</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(R^2) = 0.8007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(N = 210)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Labor Effect \((e^{t\psi_l})\) | 0.0270 |
Investment Effect \((e^{t\psi_k})\) | 0.1052 |
Defense Growth Effect \((\pi_d(D/Y) + e^{t\psi_d})\) | 0.0760 |
Defense Size Effect \((\lambda\pi_d)\) | 1.4193 |
Non-Defense Growth Effect \((\pi_n(n/Y) + e^{t\psi_n})\) | 0.2886 |
Non-Defense Size Effect \((\lambda\pi_n)\) | 0.5973 |

* Significance at 0.1
** Significance at 0.05
*** Significance at 0.01.
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 about 1.42 percent. Similarly, a one percent increase in non-defense spending is expected to increase growth by approximately 0.29 percent, and a one percent increase in the ratio of non-defense spending to GDP will increase growth by about 0.60 percent. Considering the growth effects on an annual basis, we find a reasonably stable relationship between government spending and the economic growth of the post-Soviet states, as shown in Figure 2. These findings indicate that, contrary to the hypothesis, defense spending has promoted growth in the post-Soviet states rather than hindered it. This is in support of Dakurah, Davies, and Sampath (2001), who argued that many less developed and developing countries will increase their

*Estimated growth effects using annual means defense and non-defense shares of GDP and $e^{\lambda}$.*

7 Given the instability of the post-Soviet economies, we tested for sensitivity in our model. The results show that the model is not sensitive to changes in the defense spending share of GDP up to 5 percent.
defense spending as their economy improves because of their past experiences in regional instability and high militarization.

Next, we explain the results of the other variables in the direct model. Although technology $\lambda$ is negative, the technological progressive factor $e^{\lambda t}$ is
always positive per the derivation of the model. To calculate the elasticities of investment and labor, we use the corresponding estimate of $\psi$ and the measure of $e^{a_t}$ at the mean of the median year of the study. As expected, technology and capital play significant roles in the economic growth of the post-Soviet states. For instance, a one percent increase in the ratio of investment to GDP leads to an increase in economic growth of 0.10 percent. Given the positive and significant effect of investment on growth, it is reasonable to conclude that any significant impact of defense spending on investment will indirectly affect post-Soviet economic growth. Contrary to traditional macroeconomic theory, the effect of labor on the economic growth of the post-Soviet states is insignificant. Given the instability of their labor markets and the transitions of sector focus from heavily government dominated to a private driven, such a finding is of no surprise.

Turning to the indirect models, the results of the estimation for the investment and employment models are reported in Table 4. Based on the results of the investment model, we find that the defense effect on investment is not significant. According to the estimates, defense spending hampers investment immediately and continues to do so in the following two years. Interestingly, these findings are in contrast to Mintz and Huang’s (1990, 1991) crowding-out hypothesis and Aschauer’s (1989) complementing hypothesis. Non-defense government spending, on the other hand, helps investment in the short term, but crowds out investment in the following two years. In other words, non-defense spending may be in competition for the same resources as defense spending and private investment. As to the other control variables, as expected, the private sector has a positive and significant long-term effect on investment, as does the available stock of capital within the post-Soviet states.

Turning to the employment model, we find that the employment effect of defense spending in the post-Soviet experience is also not significant. In contrast to Heo and Eger’s (2005) and Henderson’s (1998) arguments that defense spending reduces unemployment, we find that defense spending neither helps nor hinders employment. Alternatively, non-defense government spending reduces unemployment in the short term but aggravates unemployment in the long term. Given that the coefficients for the short-run and long-run effects (-0.3152 and 0.2318, respectively) are relatively close in size, the effects of non-defense government spending on employment may cancel each other out in the long term.

SECTION IV: ANALYSIS AND CONCLUSION

The collapse of the Soviet Union in December of 1991 created a ripple effect that spread across the globe, affecting numerous governments, economies, and defense

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8 The long-run coefficient for non-defense spending on employment (0.2318) is obtained by summing the coefficients at $t-1$ and $t-2$. 
policies. One of the most important questions stemming from the collapse is how the defense sector has impacted the economic performance of the 15 states of the former Soviet Union. Despite attention paid to the defense-growth relationship and the development of the post-Soviet states, absent from the literature is a discussion of how a shift in the defense burden has impacted the states as they struggled to become independent states, free of Soviet control. To investigate the defense effects, a nonlinear production function based on neoclassical growth theory was adopted to test for direct effects. For indirect effects from a transition in the defense sector, models of investment and employment were also adopted. These models were then tested using data from post-Soviet states between 1992 and 2007.

Contrary to expectations, the results of our empirical analysis reveal that defense spending has a positive effect on economic growth. We find that a one percent increase in defense spending is expected to produce an increase in economic growth by 1.42 percent. The indirect impact of defense spending on growth, on the other hand, tends to be negative. These effects, however, are insignificant. Given the findings from the investment and employment models, and that investment and labor both promote economic growth, we can conclude that defense spending has no indirect effect on the post-Soviet economies. We also find that non-defense spending has a positive effect on economic growth, such that a one percent increase in non-defense spending produced about a 0.60 percent increase in economic growth. Indirectly, non-defense spending also tends to have a negative effect. 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.

The current reductions in defense spending cannot simply be attributed to the end the collapse of the Soviet Union or the end of the Cold War. The reductions are also due to the budgetary difficulties that affect many of the post-Soviet states. Thus, downsizing often reflects the response of government administrators rather than any national plan for restructuring the defense sector. As indicated in Figure 1, per capita defense spending peaked in the late 1980s with spending at about $1100 per person, falling precipitously until about FY1996, bottoming out at about $50 per person in the post-Soviet era, and then climbing from FY1997 through FY2007 at a slower rate than in the Soviet era of our dataset.

It appears that reductions in defense may be negatively affecting growth and should be undertaken with caution to avoid future economic problems. Any policy alternative that involves economic stimulus by reducing the state’s defense spending needs to be more closely scrutinized as such policies may have questionable success. Although defense cuts can assist in lowering the overall
government expenditures to a manageable budgetary level, the negative effect leaves the potential for additional budgetary problems as the loss of economic growth forces the state into economic difficulties.

The findings of this study suggest that the concepts behind the defense-growth relationship are more complex than the simple transfer of resources from the defense sector and the private sector. As Heo (1998) pointed out, the reallocation of resources from the defense sector may not promote growth due to poor economic performance of that sector. Thus, any defense decreases must be made with caution and parsimony. The post-Soviet states receiving the benefits of a militarized economy may need to analyze the use of their resources, so that any decline in the defense sector only occurs at the rate by which other sectors are able to use the resources more efficiently and effectively.

Although the findings of this paper are important, they should be interpreted and applied with caution. The significance of the results for the post-Soviet states is limited by a shortage of data. The data obtained for this study are best estimates from societies facing economic collapse and governmental insecurity. Although the Soviet Union collapsed in 1991, data for little more than a dozen years are available for use and testing. As the period between the collapse and the present increases, future research should therefore be conducted in order to validate these findings over longer durations of time, using political specifications and the occurrence of political change.

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