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The controversies of destructive spending: Arms production and growth in the post–Cold War era

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Abstract

Critics of the GDP measure are claiming that it fails to capture the true well–being of a country and demand that alternative measures be developed. To determine how the destructive spending on arms should enter a new measure, an understanding of its effects on GDP is required. The literature focusing on how arms production and spending on defense impact economic growth is neither conclusive nor consistent. This paper assesses the methods used by the current body of literature with the purpose of moving the discussion beyond its current impasse. Regressions with OLS, GLS, fixed, and time–fixed effects on unbalanced panel data during 1995–2014 are performed to examine the growth effects of military spending, arms trade and war. The results are ambiguous in spite of these efforts, indicating that a new approach is needed. Lastly, suggestions on where to go from here are given.

Keywords: Arms trade, Beyond GDP, Defense spending, Economic growth, Military expenditure, Security threats
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1. Introduction

Today, the key indicator of a country's economic welfare is the measure of the Gross Domestic Product (GDP). The more the GDP grows, the better the economy is doing. Strictly speaking, GDP is a measure of value added through production, not a measure of welfare. An illustrative example is that the reconstruction costs after a war will boost a country's GDP. The previous destruction of physical property or the human suffering is not considered.

The rationale behind how to measure national income has been heavily debated and set off in a wide range of directions from its very beginning. Also Simon Kuznets, who contributed in giving the GDP measure its current shape, was critical to how it failed to capture a country's well–being to its full extent. In the 1940s, John Maynard Keynes contributed with its modern definition: the sum of an economy's consumption, investment, government spending, and net exports. This implied a shift from Kuznets' definition in the sense that government spending was no longer seen as a cost of private sector production. However, it did little to address the problem of value added as an indicator of welfare and well–being. That the issue was indeed considered a problem also outside the narrow circles of professional economists is eloquently illustrated by the following quote:

> Yet the gross national product does not allow for the health of our children, the quality of their education, or the joy of their play [...] it measures everything, in short, except that which makes life worthwhile.
>
> —Robert F. Kennedy, University of Kansas, Lawrence, Kansas, March 18, 1968

In 2009, Joseph Stiglitz was asked by the President of France to create what later came to be called The Commission on the Measurement of Economic Performance and Social Progress. The commission's aim was to investigate how GDP fails to capture economic and social progress and to make recommendations of methods that could be used to complement today's measurements. Stiglitz and his co-researchers emphasize the need of alternative measures perfecting GDP and the necessity to account for inequalities and the depletion of resources that is created by the society and the production in it (Stiglitz, Sen, and Fitoussi, 2009). But nine years after the release of the report, production leading to the depletion of non-renewable resources is part and parcel to the components that are included in the GDP measure. Still, GDP is the most accurate and wildly used measurement of welfare.

The continuing discussion about how 'defensive' and 'regrettable' expenditure (Allin and Hand, 2017) should be handled brings up the controversies associated with them. One area where this is very evident is military expenditure and the related arms production. There is no doubt that the arms industry is answerable for much of the destruction and misery around the globe. Worse still, it seems to increase. A report from Stockholm International Peace Research Institute (SIPRI, 2017) shows that arms sales by the 100 largest corporations within the industry have increased with 38% since 2002. Intuitively, the arms industry fulfills every criterion for being a deplorable type of addition to the GDP.

It is not entirely black and white, however. The original purpose of possessing arms is to be able to attack or defend against an enemy. Additionally, countries that would lose investments because of a higher security threat could stop the downward going spiral by acquiring arms to protect citizens and property rights. In this context and throughout this paper, security threats is limited to those that arms could be effective against. This would mean that a country under attack is actually enhancing its welfare when increasing its arms production. Indeed, this is the rationale commonly used within the defense literature. Nevertheless, this original definition of the purpose of possessing arms can be criticized for being too narrow and ignoring the signaling effects of producing weapons.

The arms industry has also been blamed for crowding out other investments. Government spending on arms could be more wisely spent on other value–enhancing institutions or industries, such as education. The destructive spending could even be replaced with a lower tax–burden for the citizens. This opportunity cost is what can make arms production have a negative effect on GDP growth, although counted as a positive entry when calculating GDP.

On the other hand, the technologies developed for the production of arms have been praised for its positive spill–over effects on other industries. The technologies developed for military equipment are often advanced and can be successfully adapted for civilian use, including for consumer goods. From this viewpoint government spending is invested in efficiency enhancements that citizens will gain from.

Conclusively, the belief that arms production should reduce welfare might be false. Whether it is, is ultimately an empirical issue. Given a security threat, having arms produced could be the best solution to increase not only economic growth, but also social welfare. However, the literature focusing on the effect of arms production and military expenditure is not in agreement on the effects, not even as regards its contribution to GDP growth. As a result, a new look at the evidence is called for. To understand how to include arms production in a new welfare measure one has to be certain about its effect on at least GDP. The purpose of our contribution is to help the discussion move beyond the current impasse by assessing the methods used by the current body of literature and suggesting where to go from here.

2. Literature review

Benoit (1978) started the debate about military expenditure and growth by claiming that more of the former would stimulate the latter. Since then, the effect of military expenditure on growth has been the subject of multiple studies with varying results. Poor quality of data combined with differing theoretical models, and econometric methods have been blamed for the ambiguity. Multiple authors, i.e Aizenman and Glick (2006), Compton and Paterson (2016), and Yakovlev (2007) claim that non–linearity and omitted variable biases contribute further to this ambiguity. Stroup and Heckelman (2001) argued that the effect of military spending on growth can be thought of as a concave function. That is, military spending exhibits diminishing marginal utility and eventually becomes negative for economic growth. The complexity of military spending is enhanced by the fact that it is often viewed as a public good.

While mainstream growth literature has not been able to find that military spending has a significant effect on growth (Barro and Sala-i-Martin, 2004), the defense literature has. As data quality has improved the majority of the studies are indicating that the military burden is precisely a burden — it inhibits growth, at least in the short run. In a study of 14 EU–countries between 1960 and 2000, Mylondis (2008), even claims that the negative relationship has grown stronger over time.

As the study of the nexus between military spending and growth has evolved, several studies have incorporated other factors to gain a deeper understanding of the complex forces at play. Dunne and Tian (2015) control for different levels of income, conflict experience, natural resource abundance, openness, and aid. Their findings are remarkably consistent with the general view that military spending inhibits growth. Compton and Paterson (2016) control for the quality of institutions, finding that weak institutions lead military spending to have a negative impact on growth while strong institutions lead it to have a neutral impact at best.

Aizenman and Glick (2006) introduce interaction–terms between military spending and external threats respectively corruption, in a study of 90 countries in the period of 1989–1998. They indeed find a non–linear relationship where military spending in general is negative for growth, even more negative in the presence of corruption, but positive in the presence of external threats. Their approach has been highly influential within the field.

In a study of 90 developing countries between 1990 and 2013, Aziz and Azadullah (2017) refines the analysis by distinguishing between external and internal threats. They find a positive and significant effect of military expenditure on growth, conditional upon internal conflict exposure while no significant effect is present for external conflicts. Their results indicate that civil wars pose a greater threat to security than wars with external parties. However, their results are highly dependent upon the different econometric methods used.

The theoretical reasoning behind the aforementioned empirical results is the following: In the face of conflict, military expenditure heightens security and can therefore contribute to higher growth while military expenditure without any perceived threats causes higher opportunity costs.

Adam Smith noted that the duty of the state was to protect its citizens from foreign and domestic oppression or violence. Pamp and Thurner (2017) wrote: "The aspect of security is therefore at the heart of explaining spending on defense." Heightened security protects persons and property rights, hence increasing incentives to invest and innovate (Thompson, 1974). However, when there is no threat to security, the resources spent on the military could be more productive elsewhere. Examples given by Mylondis (2008) are crowded–out public and private investment, adverse balance of payments in arms importing countries, inefficient bureaucracies, fewer civilian public–sector services, depleted R&D activities, and less skilled workforce in the civilian sector. These opportunity costs outweigh the positive externalities of military spending, such as developed infrastructure, improved human capital, and development in technology.

Another possible channel for increasing security is through arms exports to allies. In Pamp and Thurners' (2017) study of the determinants of military spending they conclude that there is a strategic substitution effect for democratic countries where more arms exports are followed by less military expenditure. To our knowledge, there is no study that explicitly studies the defense–growth nexus and allows for both arms trade and threats.

Yakovlev (2007) conducted a study in a fashion similar to the one Aizenman and Glick undertook. In a study of 28 countries between 1965 and 2000 he studies the defense–growth nexus, adding net arms exports and an interaction term between military expenditure and net arms exports. Yakovlev empirically shows that arms exports in general are negative for economic growth but that the interaction with military expenditure is positive. However, the theoretical rationale behind it is unclear. "This means that higher military spending and net arms exports separately lead to lower economic growth, but higher military spending is less damaging to growth when a country is a net arms exporter." Yakovlev argues that the non–linearity exhibited by arms exports can be explained by economies of scale in the production of arms. This also explains the prevalent intra–industry trade of arms.

Whilst this research has been put forward, there has been a shift in the environment in which these studies take place. The end of the Cold War lead armaments to be traded differently. During the Cold War, arms imports often came in the form of aid, was paid through barter deals, or bought on credit (Brzoska, 2004). Consequently, the full cost of the arms imports was often not reported in military budgets. Brzoska (1995) argues that if they were fully accounted for, "arms transfer data would be increased by one fourth to one third." After 1991, the arms trade has become more commercialized and less bound by alliances. This may create biases in studies such Yakovlev's, that use arms data that span over both the Cold War era and the post–Cold War era.

However, there are indications that the commercialization of arms has led to escalating conflicts. Since the Cold War, the fraction of interstate conflicts has decreased while the fraction of internal conflicts has increased (Gleditsch et al., 2002). Although the conflicts are internal, foreign states are more often than not involved in the sense that they offer military, financial, or logistic support (Harbom and Wallensteen, 2005). The commercialization of arms trade has made major conventional weapons readily available for rebel groups. A study by Moore (2012) indicates that their use of these lead to conflict escalation and higher mortality.

In summary, their is no consensus regarding how military expenditure affects economic growth but a growing body of literature suggests that the effect in general is negative. An influential study by Aizenman and Glick (2006) and studies following theirs indicate that military spending could be positive for growth conditional upon exposure to security threats.

2.1 Research question

The rest of this paper will be devoted to answering the following question:

> *How does arms production, proxied by military expenditure and net arms exports, impact economic growth?*

Based on the rationale presented in previous sections we pose the hypothesis:

> *Arms production have adverse effects on economic growth when countries do not experience security threats. However, arms production alleviates the negative effects of security threats and therefore increases economic growth in the presence of them.*

3. Method

This section will outline the Barro growth model and the motivation for choosing it as our theoretical model. Lastly, the model specification of our regression and potential issues considering it will be given.

3.1 Choice of model

Dunne, Smith and Willenbockel (2005) point out that the Feder–Ram model, a growth model commonly used in defense economics, has several limitations. These limitations include an incapability to account for intra–sectoral organizational inefficiencies and are so severe that they suggest that it be abandoned for the Augmented Solow model or the Barro model. Dunne et al. argue that the Augmented Solow model is theoretically stronger than the Feder–Ram model but is too narrow in its specification of variables. Moreover, the assumption that military expenditure mainly affects growth through technology is questionable. Conclusively, the Barro model seems more promising.

The Barro model does not get explicit parametric restrictions as does the Augmented Solow model. Moreover, it is less tight in its specifications and allows for adding of variables that are related to growth. Although arms trade is not specified within the model, Yakovlev (2007) adds it in an ad–hoc fashion. It would certainly be more desirable for arms trade to enter the model in its theoretical specification by explicitly affecting the productivity level. As the Barro model nonetheless allows for this ad–hoc adding of variables, we will follow the example of Yakovlev.

3.2 The Barro growth model

In the Barro growth model (Barro, 1990) government expenditure has a non–linear effect on growth due to productivity enhancing and tax distorting effects. We borrow an extension of the Barro growth model from Aizenman and Glick (2006). The model abstracts from transition dynamics and technological spillovers as it assumes steady state and consists of a single sector. A summary of the model follows below, see Barro and Aizenman et al. for the full derivations.

The production function is given by:

$$y = Ak^{1-\alpha} g^{\alpha} f \tag{3.1}$$

where y is output per worker, A is an exogenous productivity factor, k is capital per worker, g is the non–military government expenditure per worker. f is the extension provided by Aizenman et.al of the Barro growth model, where $1 - f$ is the cost of any existing security threat. Capital is viewed in a broad concept, including both physical and human capital. The cost of threat depends positively on the magnitude of the threat and negatively on military expenditure:

$$f(g_m, z) = g_m/(g_m + z); \tag{3.2}$$

$$f_{g_m} > 0,\ f_z < 0;\ f(0, z) = 0;\ f(\infty, z) = 1;\ 0 < f < 1$$

where g_m is military expenditure and z is the threat level posed by a security threat. Substituting the function for f into the production function yields:

$$y = Ak^{1-\alpha} * g^{\alpha} \frac{g_m}{g_m + z} \tag{3.3}$$

The ratio of arms production to non–military government spending is given by φ,

$$g_m = \phi * g \tag{3.4}$$

Accordingly, the total government expenditure is given by $(1 + \varphi)g$. Government expenditure is financed by a proportional tax rate τ:

$$(1 + \phi)g = \tau y \tag{3.5}$$

From the above, it is clear that output is an implicit function of the share of military expenditure and tax rate. The rest of the model is the same as Barro's. Workers maximize their utility given by:

$$U = \int_0^{\infty} \frac{c^{1-\sigma} - 1}{1 - \sigma} exp(-\rho * t)dt \tag{3.6}$$

where c is consumption, ρ is the constant rate of time preference, and $-\sigma$ is the constant elasticity of marginal utility. Hence, the production growth rate per worker is:

$$\tilde{\gamma} = \frac{1}{\sigma}\left[(1 - \tilde{\tau})\frac{\tilde{y}(1 - \alpha)}{k} - \rho\right] \tag{3.7}$$

The optimal tax rate and share of military spending (optimal values are denoted by tilde) when maximizing the growth rate are:

$$\tilde{\tau} = \alpha(1 + \tilde{\phi}) \tag{3.8}$$

$$\left(\tilde{\phi}\right)^2 \alpha \left[\alpha\right]^{\frac{1}{1-\alpha}} \left[1 - \alpha\tilde{\phi}\right]^{\frac{\alpha}{1-\alpha}} A^{\frac{1}{1-\alpha}} = \frac{z}{k} \tag{3.9}$$

In the absence of military expenditure, the optimal tax rate is simply the marginal product of non–military spending, α, seen in Equation (3.8). From Equation (3.9) we can infer that the share of military spending depends positively on threat. This in turn yields that the tax rate depends positively on z. Threat affects growth adversely through two channels: z decreases the marginal product of capital and indirectly increases the tax rate through the lowered productivity.

Lastly,

$$\frac{\partial \tilde{\gamma}}{\partial \tilde{\phi}} < 0 \tag{3.10}$$

$$\frac{\partial^2 \tilde{\gamma}}{\partial \tilde{\phi} \partial z} > 0 \tag{3.11}$$

confirms a non–linear theoretical relationship between growth and military expenditure. This relationship is carried over to the model specification in the next subsection. As pointed out before, the lack of restrictions of the Barro–style regression allows for adding of variables that are not explicitly included in the theoretical model. Hence, net arms exports is added and the non–linearity is thereto applied to this variable.

3.3 Model specification

The following model specification is used for this paper:

$$\begin{aligned} growth = {} & \beta_0 + \beta_1 milex + \beta_2 armex + \beta_3 war \\ & + \beta_4 (milex)(war_i) + \beta_5 (armex)(war_i) + \beta X + \varepsilon \end{aligned}$$

where *growth* is annual growth (%) in GDP per capita, *milex* is military expenditure over GDP, *armex* is net arms exports, war_i is a country's war–exposure, and X is a set of control variables. Based on our hypothesis, we expect β_1, β_2 and β_3 to have negative signs while we expect β_4 and β_5 to have positive signs.

3.4 Potential issues

There is a possibility that, despite the inclusion of *armex*, the model specification suffers from omitted variables. If this is the case, the coefficients of our variables would be wrongly estimated and hence, be biased. To prevent any omitted variable biases we have included variables commonly used among researchers within the field. A variable unforeseen by the field is consequently also left out from our model specification.

One possible omitted variable is population size, but only if military expenditure is viewed as a public good. Logically, every country would have to spend the same sum (in monetary terms) to be able to protect its citizens independent of population size. Hence, small countries with fewer tax paying citizens suffer from disadvantages because of their size. As a result, the size of a country could be an important determinant of how much to spend on defense.

Another plausible concern is the addition of the interaction terms. When included, they reduce the degrees of freedom drastically. This should however, not be a matter of concern. The dataset entails a large number of observations, which offsets the reduction of degrees of freedom.

4. Data

The dataset consists of unbalanced panel data and includes 53 countries covering the time period 1995–2014. The post–Cold War era is a relatively unexplored time period. As mentioned, there has been a shift in the manner of warfare as well as arms trade that might have altered the relationship between arms production and growth.

The following sections include detailed descriptions of data sources and how variables are constructed. A brief discussion about issues that may arise with our choice of variables continues thereafter. Lastly, we turn to the macro–perspective in order to elucidate the complexity of the field.

4.1 Variable description

The dependent variable that reflects economic growth is taken from The World Bank's World Development Indicator Database (WDI, 2018) and constructed as annual growth (%) in GDP per capita. Using growth rate per capita is consistent with the underlying theoretical model, the Barro growth model, that expresses output in terms of output growth per agent.

The independent variable *milex* is taken from SIPRI (2018) and reflects military expenditure as a percentage of total GDP. Military spending relative to GDP naturally corrects for business cycles. Hence, it is less sensitive to output shocks than the level of military spending. It can therefore decrease potential endogeneity problems.

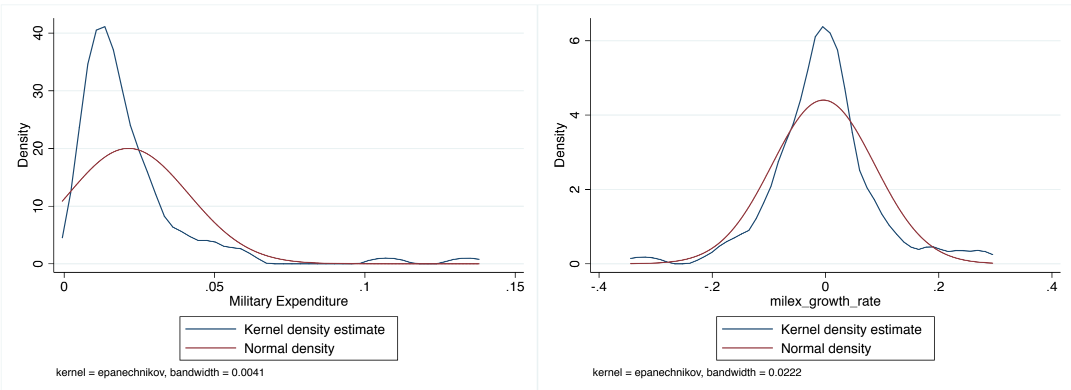
SIPRI (2018) is also the data source used for the independent variable *armex*. They report the international flows of major conventional arms expressed in units, that is, not it monetary terms but in number of weapons. Following Yakovlev (2007), the variable is calculated as a share of total trade flows:

$$armex = \frac{(arms\ export - arms\ import)}{(arms\ export + arms\ import)}$$

The independent variable war_i exists in two versions for the purpose of using different types of regressions. Regardless, war_i is based on data from The Uppsala Conflict Data Program (UCDP, 2017) and reflects if a country has been at war. A war is defined as having at least 1000 battle–related deaths in a year. war_1 is a dummy variable which displays 1 in the year that a country is at war and for the next four years. The purpose of the protracted factor is to reflect the lingering effects of serious conflicts. Consequently, war_1 takes on different values over the years within a country and can be used for regressions using fixed effects with panel data. war_2, on the other hand, is fixed for a specific country but more precise in the sense that it is not a dummy. war_2 is the number of years that a country has been at war during the time period in question and can be used for cross sections.

Our model includes four control variables commonly used in growth models: *ln_initial_gdp*, *ln_capitalformation*, *ln_educ* and *pop_growth_rate*. *ln_initial_gdp* is the log of GDP per capita (current USD) in 1995 taken from WDI (2018). *ln_capitalformation* formation is the log of gross capital formation at current PPPs taken from Penn World Tables (Groningen Growth and Development Centre, 2017) and reflects the accumulation of capital. *ln_educ* is the log of average years of schooling for the total population, taken from Barro Lee Educational Attainment Dataset (2016). *pop_growth_rate* is the annual population growth rate, given by Penn World Tables (2017). The change in population is included because the dependent variable GDP is expressed in per capita and we expect that changes in population will affect this measure.

4.2 Potential issues



(A) *milex* (B) *milex_growth_rate*

FIGURE 4.1: Skewness of the variable *milex* and *milex_growth_rate*

As the dependent variable *growth* reflects change, a question arises about how to match the independent variables. This consideration is especially important for *milex* where we can choose to either look at the level or the change in level of military expenditure/GDP . The choice should depend on how we expect *milex* to influence growth. As security threats are at the center of our attention, we are primarily interested in what happens if a country raises its *milex* when a war takes place. Hence, the initial level of *milex* is of secondary nature. In our panel data analysis, we therefore choose to compute *milex* as the change in *milex*. To avoid confusion, it is labeled as *milex_growth_rate* when using the change. Furthermore, as can be seen in Figure 4.1, the variable *milex_growth_rate* is less skewed.

Another potential issue is that the data on *armex* is not expressed in monetary terms. The variable may be subject to some bias if a country imports weapons of other types and at other price levels than they export. World Military Expenditures and Arms Transfers (WMEAT) do provide data on arms trade in monetary terms. However, it is not as extensive as the data collected by SIPRI.

milex and *armex* are acting as proxies for arms production. Either a country buys or produces weapons for its own use, reflected in the military budget, or it sells it to other countries, reflected in net arms exports. However, *milex* captures many other costs of the military. In lack of data that only show the part of the military budget spent on arms, we still choose to use total *milex*. Moreover, we are not able to distinguish between military expenditures that goes into value enhancing activities and those that are detrimental to growth. The field in whole, is limited by this ambiguity but has up until this point not been able to part the two effects.

The variable war_i acts as a proxy for security threats, even though security threats can take on many different forms. Thereto, it is quite simplistic in the sense that it does not account for the severity of the war, if the neighboring countries are at war, or separate between civil and interstate wars.

If one would compare *milex* to g_m and war_i to z in the Barro growth model, it would be apparent that the units are incompatible. *milex* would rather be expressed in military spending per capita and war_i would be expressed in comparable units so that they can be aggregated. As previously discussed, there are reasons to define *milex* in terms of share of total GDP, preventing us from staying true to the theoretical model.

Lastly, the data reliability can be questioned. Most of the data is reported by the countries themselves and could be subject to both intentional and unintentional errors.

4.3 Descriptives

TABLE 4.1: Summary statistics

Variables	Mean	Std.Dev.	Min	Max
milex	0.0220	0.0143	0.00465	0.0866
milex_growth_rate	-0.0136	0.0743	-0.258	0.488
armex	-0.172	0.697	-1	1
war_1	0.0737	0.261	0	1
war_2	0.966	2.447	0	14
ln_initial_gdp	9.105	1.358	5.914	10.793
pop_growth_rate	0.00925	0.0151	-0.0152	0.162
ln_capitalformation	-1.421	0.261	-2.966	-0.491
ln_educ	2.234	0.287	1.185	2.597

As can be seen in Table 4.1, the mean of *milex* of 2.2% shows the average percentage of total GDP spent on the military. The mean of *milex_growth_rate* is –1.36%, meaning that military budgets have decreased during the period studied. However, this variable experience big swings due to the nature of it. Events such as political shifts or participation in wars can reduce or increase the military budget. The mean of *armex* is also negative, meaning that more countries in our sample are net importers rather than net exporters. There are both countries that only import (Min = –1) and only export (Max = 1) arms.

TABLE 4.2: Pairwise correlation between variables

	GDP per capita	milex growth_rate	armex	war_1	ln_initial GDP	pop_growth rate	ln_capital formation
GDP per capita	1.0000						
milex_growth_rate	-0.2097*	1.0000					
armex	-0.1592*	-0.0303	1.0000				
war_1	0.0400	0.0654	-0.0518	1.0000			
ln_initial_gdp	-0.3585*	-0.0366	0.3704*	-0.1331*	1.0000		
pop_growth_rate	-0.2654*	0.0774 *	-0.2665*	0.0492	0.0111	1.0000	
ln_capitalformation	0.1075*	-0.0313	-0.0781*	-0.0909*	0.2738*	0.1777*	1.000

* $p < 0.05$

Table 4.2 shows that the pairwise correlations between the independent variables are quite low, indicating that perfect multicollinearity will not be an issue. As no correlation exceeds 0.37 they can be viewed as nontrivial. However, the low correlation between individual variables cannot guarantee no multicollinearity as we are dealing with multiple variables.

4.4 Macro–perspective

The resources spent on military expenditure over GDP (*milex*) and the number of wars in the world have had a clear shift in trend after the Cold War (1991). Figure 4.2 shows that the period of this study (the shaded area) is characterized by a lower and decreasing *milex* coupled with a decreasing number of wars around the world. Looking back it is apparent that certain trends have dominated in specific time periods. The first one ending around 1965 is characterized by high values for *milex* in relation to the number of wars. The next time period around 1965–1991 outlines a time period dominated by high *milex* as well as number of wars. Looking ahead, it seems like the trend is shifting again after the time period studied. Note that *milex* is not expressed in monetary terms and that an increase in total GDP means more real money spent on military expenditures, holding the percentage of GDP constant.

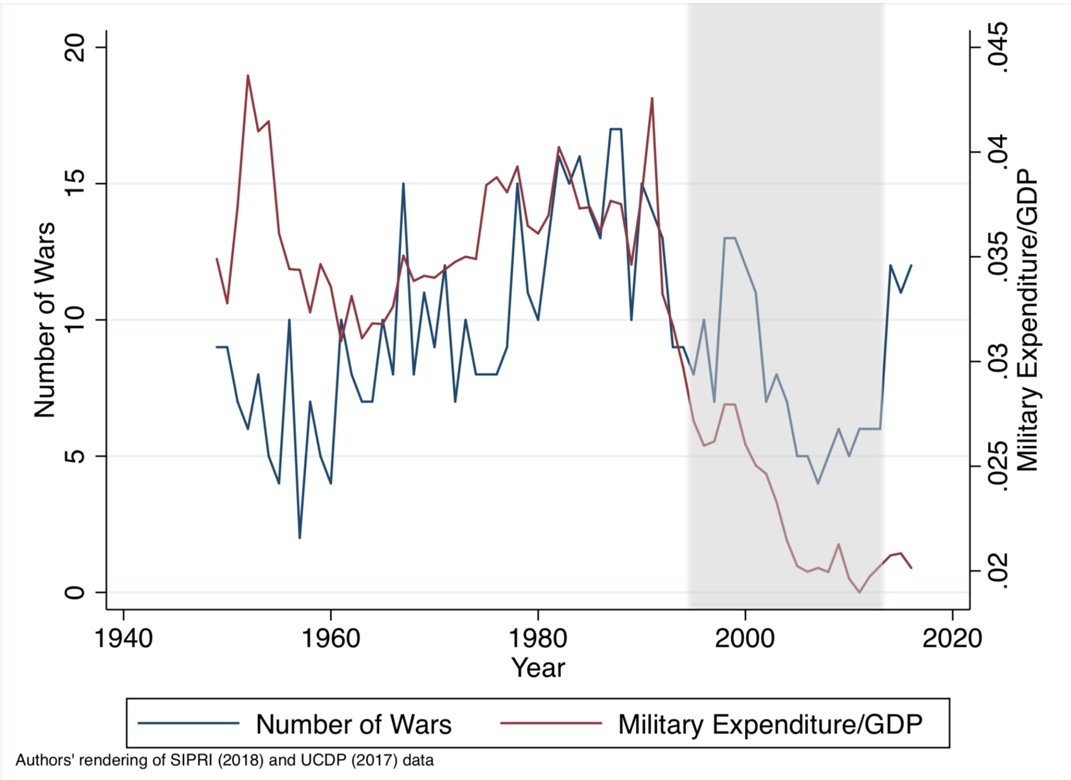


FIGURE 4.2: Number of wars and the average military expenditure as a percentage of GDP, worldwide, 1949–2016. The shaded area represents the period studied.

Standing at different points in time and assuming benevolent and rational governments, it is plausible that different preconceived ideas about *milex*, *war*, and *growth* dominated amongst researchers. In the first period in Figure 4.2, a speculation could be that there are other factors than war influencing the high *milex*. In the second period, one could assume that the high spending on the military is used to tackle wars. In the period studied, a third theory could be dominating the field.

In the shaded area in Figure 4.2 one can suspect that the two variables co–variates more during the time of our study than during other periods. Another remark is that the decreasing trend in both *milex* and number of wars seems to be dampened some time before 2010, indicating that the trend is shifting within the period studied as well.

TABLE 4.3: Countries that have experienced war between 1995 and 2014.

Countries			
Australia	India	Malaysia	Thailand*
China*	Indonesia	Pakistan	Turkey
Colombia	Iran*	Peru*	United Kingdom**
Egypt	Israel**	Russia**	United States**

* Country has been net arms exporter at least once
** Country has been net arms exporter on average

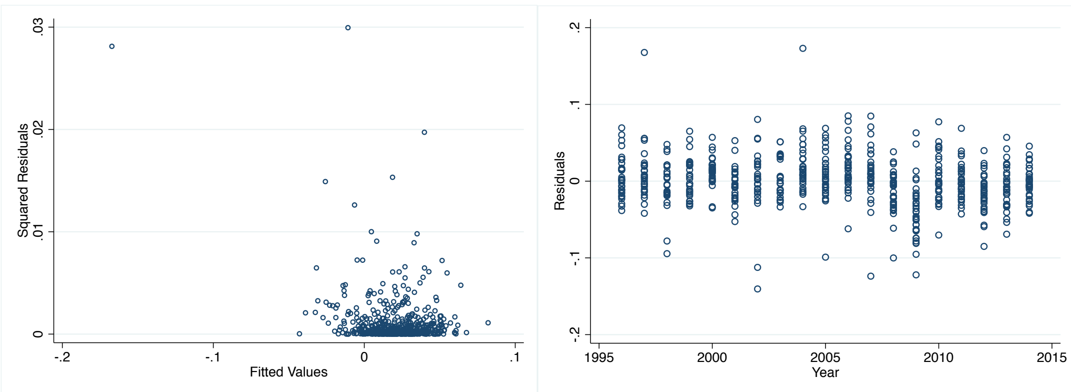
Table 4.3 shows the countries in our sample used in the panel regressions, that have experienced war during the studied time period (1995–2014). 16 countries have experienced war whilst 37 countries have not. Countries assigned a star have been net arms exporters during at least one year. Countries assigned two stars are on average net arms exporters during the entire period. Remarkably, 8 out of 16 conflict countries have been net arms exporters at some point. This should however be viewed critically. As pointed out by Yakovlev (2007) developed countries are in general net arms exporters while developing countries are net arms importers. There is a possibility that the share of arms exporters at war in our study, is high because developed countries report data to a larger extent than developing countries. Hence, many arms importers at war can be missing from our sample due to lack of data.

5. Results

This section is divided into panel data regressions and cross–sectional regressions and ends with the limitations of the regressions performed. The range of methods are used with the purpose to control for the ambiguity displayed in previous research.

5.1 Regressions with panel data

The regression analysis starts out with an unbalanced panel dataset of 53 countries spanning over a period of 20 years, 1995–2014. The three regressions displayed in this section (Table 5.1) are using random effects (GLS), fixed effects and time–fixed effects respectively. Further details are outlined below.



(A) Squared residuals against $\hat{Y}$ (B) Residuals against time

FIGURE 5.1: Heteroscedasticity and autocorrelation based on the fixed effects model

The error terms approximately follow a normal distribution, discharging the violation of the conditions of the Classical Normal Linear Regression Model that follow with error terms that are not normally distributed. To check for heteroscedasticity, the data is first examined graphically (Figure 5.1 (A)) with squared residuals plotted against the fitted values of the fixed effects model. There are no obvious signs of non–constant error variance, the squared residuals are possibly somewhat larger for higher fitted values. However, a modified Wald test for groupwise heteroscedasticity shows that heteroscedasticity is present. Possible reasons for the non–constant error variance are the presence of outliers and omitted variables. These issues are discussed below.

The sample of countries are entirely based on data availability, hence the countries included are heterogeneous in most aspects. On the other hand, the countries are homogeneous in the sense that data reporting in itself is characteristic for certain kinds of countries. Furthermore, factors that are detrimental or favorable for economic growth are plentiful. The seemingly most important ones are included, but the possibility that variables significantly related to growth have been excluded, should not be overlooked.

The data is also examined graphically to detect possible autocorrelation (Figure 5.1 (B)). Already at this stage, it is easy to identify autocorrelation. The residuals from the fixed effects model seem to be moving in cycles. Also, the Lagram–Multiplier test for serial correlation performed on the fixed effects model clearly indicates that serial correlation is present. There are multiple possible reasons for this, the most indisputable one being inertia or sluggishness. Yearly GDP growth is anchored in past growth, leading it to not exhibit a random walk over time. Moreover, periods of recessions and booms result in cyclical movements. As an example, the model overestimates the growth in the aftermath of the financial crisis 2007–2008 as economic situation is not controlled for. This can also be seen as a specification bias where variables such as economic situation has been excluded.

We have not tested for cross–sectional dependence, also known as contemporaneous correlation because of relatively few years in our panel data and a large number of observations. Given these conditions the regression should not experience such a problem.

The Breusch–Pagan Lagrange multiplier shows that random effects are to be chosen over a simple OLS–regression. Due to the presence of heteroscedasticity and autocorrelation, GLS is used. GLS together with robust standard errors correct for these issues. Furthermore, it is an effective method when dealing with unbalanced panel data. The results can be seen in Column (1) of Table (5.1). The majority of the coefficients of the main variables are significant. *milex_growth_rate* and *armex* are significant and display the expected negative relationship with economic growth. war_1 and $milex\_growth\_rate * war_1$ are both insignificant and have unexpected relationships with economic growth. war_1 has a positive relationship, meaning it would enhance a country's GDP if increased. $milex\_growth\_rate * war_1$ has a negative relationship with economic growth, implying that an increase in military expenditure given a war would affect GDP negatively. All control variables are significant and have the expected signs.

Next, we perform a Hausman test with the result Prob > Chi2 = 0.0009. With a 0.1% level of significance we can conclude that a fixed effects model would suit the data better than a random effects model. Running a fixed effects regression eliminates the time–invariant factors within one country. Note that fixed effect regressions using an unbalanced data set requires more than one observation to be able to take differences over time. Time–demeaning with only one observation would yield zeros. The result from running a regression with country–fixed effects can be seen in Column (2) in Table 5.1. The results are very similar to the regression with random effects. A difference is that the direction of the coefficient of war_1 is the opposite, showing a negative relationship between war and economic growth, which consents with the findings of Aizenman and Glick (2006). However, it is not statistically significant.

Lastly, we test if time–fixed effects should be used. We can reject the null hypothesis that the dummies for all of the years are equal to zero. Hence, controlling for time is necessary and this regression is therefore the most relevant model of the panel regression models. Column (3) shows the regression with time–fixed effects. The coefficient of *milex_growth_rate* should be interpreted as the following: An increase of military spending of one percentage point would lead the growth rate of GDP to decrease by 0.05 percentage points on average, given no war present and keeping all other variables constant. As can be seen for $milex\_growth\_rate * war_1$, experiencing war further decrease GDP growth if military expenditure is increased. Nonetheless, this interaction term is insignificant so the coefficient does not say much in reality.

Comparing the time–fixed effects model to the other regressions, it is apparent that two of the main variables, *milex_growth_rate* and war_i are significant and have the expected directions. The time–fixed effects regression shows the largest R^2 values. We should not get too excited about this R^2. It is not surprising that we can explain much of the variation in economic growth when including year dummies.

Notable for all the regressions, is that we have excluded *ln_educ*. Education does not vary enough over time and would naturally be excluded from the regression analysis with the fixed effects methods used. When *ln_educ* was included in our regressions we could not estimate the return to education accurately (large p–values close to 1). Moreover, Barro and Sala-I-Martin (2004) empirically find a stronger positive relationship for education of the male population than for the total population. Nevertheless, substituting our variable *ln_educ* to a variable that only contains years of schooling for the male population does not alter this result.

TABLE 5.1: Panel data regressions between 1995 and 2014.

	(1) GLS	(2) Fixed effects	(3) Time–fixed effects
milex_growth_rate	–0.103***	–0.0985***	–0.0507*
	(0.0122)	(0.0279)	(0.0214)
armex	–0.00430**	–0.00893**	–0.00314
	(0.00138)	(0.00296)	(0.00238)
war_1	0.00341	–0.0000967	–0.0110**
	(0.00317)	(0.00269)	(0.00390)
milex_growth_rate	–0.0623	–0.0991	–0.0450
$\times$ war_1	(0.0444)	(0.0759)	(0.0541)
armex	0.00999**	0.00758*	0.00234
$\times$ war_1	(0.00325)	(0.00360)	(0.00475)
ln_initial_gdp	–0.0109***	–	–
	(0.000845)		
pop_growth_rate	–0.817***	–0.852***	–0.916***
	(0.107)	(0.0662)	(0.0706)
ln_capitalformation	0.0407***	0.0462***	0.0475***
	(0.00430)	(0.0108)	(0.00980)
year=1996	–	–	–
year=1997	–	–	–0.00266
			(0.00383)
year=1998	–	–	–0.00903
			(0.00599)
year=1999	–	–	–0.00633
			(0.00594)
year=2000	–	–	0.0107**
			(0.00400)
year=2001	–	–	–0.00960
			(0.00627)
year=2002	–	–	–0.00732
			(0.00472)

Continued on next page

Table 5.1 – continued from previous page

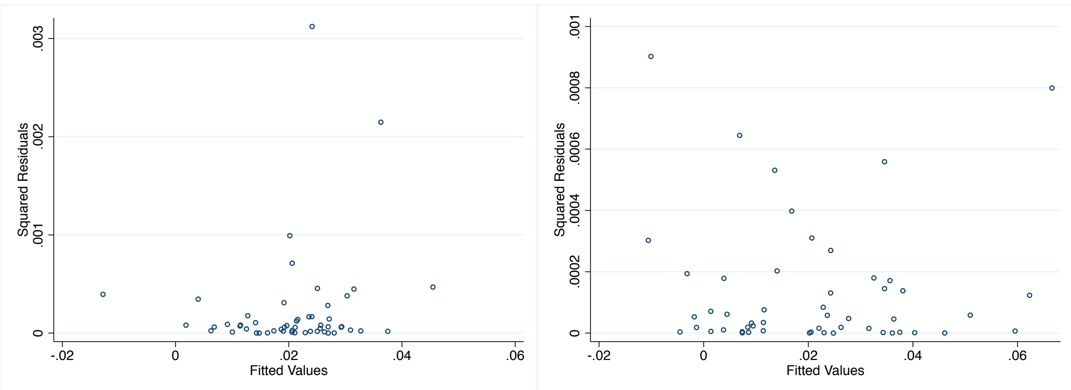
	(1) GLS	(2) Fixed effects	(3) Time–fixed effects
year=2003	–	–	–0.0000154
			(0.00374)
year=2004	–	–	0.0131**
			(0.00454)
year=2005	–	–	0.00369
			(0.00350)
year=2006	–	–	0.0119**
			(0.00399)
year=2007	–	–	0.00709
			(0.00457)
year=2008	–	–	–0.0209***
			(0.00495)
year=2009	–	–	–0.0568***
			(0.00622)
year=2010	–	–	–0.00289
			(0.00610)
year=2011	–	–	–0.00746
			(0.00518)
year=2012	–	–	–0.0302***
			(0.00486)
year=2013	–	–	–0.0197***
			(0.00443)
year=2014	–	–	–0.0135**
			(0.00450)
Constant	0.186***	0.0933***	0.106***
	(0.0119)	(0.0154)	(0.0148)
Observations	651	651	651
R^2	–	0.196	0.497
Adjusted R^2	–	0.188	0.477

Standard errors in parentheses.
R^2 values are not included for the GLS regression because of their inaccuracy.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.2 Regressions with cross–sectional data

As seen in the previous section all the panel regressions show similar results. Taking the averages of the same data, cross–sectional regressions are performed to test how sensitive the results are to other econometric approaches. In the debate about the advantages and disadvantages of the two methods, some claim that within–country and between–country regressions measure different things. A disadvantage of the yearly panel data is that it likely suffers from larger measurement errors than the averages in the cross–sectional data. If the independent variables are more time persistent than the measurement errors, the fixed effects model for panel data will even magnify the errors in measurement (Dunne, Smith, and Willenbockel, 2005).

To perform a cross–sectional analysis the data has been divided into two time periods. The main purpose of this procedure is to check if the results are robust over time. Moreover, it makes our results comparable to the study of Aizenman and Glick (2006) where averages from the period 1989–1998 were used for cross–sectional regressions. Thence, averages for the 10–year periods are run for every variable. Two different versions of the variable war_2 is constructed. war_{2e} represent wars during the first 10 early years whereas war_{2l} represents the late 10 years. This creates two distinct datasets, entirely derived from the panel dataset used in the previous section. Thereto, we have included an average of the entire period of 20 years.



(A) Squared residuals against $\hat{Y}$ 1995–2004

(B) Squared residuals against $\hat{Y}$ 2005–2014

FIGURE 5.2: Heteroscedasticity for the two cross sections

Since there are no time series, we do not have to test for serial correlation. Still, there might be heteroscedasticity present. The squared residuals can be studied visually in Figure 5.2. For the first time period (A) there are a few outliers that make the squared residuals greater as the fitted values get larger. The pattern is slightly different for the second time period (B) where the squared residuals are big for both the lower and the higher fitted values, creating a V–shaped impression. The White's general heteroscedasticity test fails to reject the null hypothesis that there is constant error variance in all periods. The White's test, known for detecting a more general form of heteroscedasticity, can easily be affected by the number of regressors and hence, lose its power. The Breusch–Pagan test, on the other hand, shows that there is no heteroscedasticity present. Consequently, robust standard errors are used for the regressions to control for heteroscedasticity, if any.

Multicollinearity between variables in our regression would imply that our coefficients are not estimated correctly. As mentioned in Section 4.3, low pairwise correlation is not a guarantee for non–multicollinearity. The variance inflation factor (VIF) can reveal which variables are redundant when generating a value above the threshold of 10. VIF reports high values for war_{2e} and the interaction term $war_{2e} * mean\_milex$ whilst all other variables are well below the threshold for the ten first years of our study (1995–2004). This would mean that we have put too many variables measuring the same phenomenon into our regression. However, when performing VIF excluding the interaction terms altogether it shows that there is no multicollinearity. It is noteworthy that war_{2e} and $war_{2e} * mean\_milex$ exclusively exhibits multicollinearity, although they are not far above the threshold, and not $armex$ and $armex * war_{2e}$. The same results are given for the regression made over the entire 20 years. VIF for the second time period in our study (2005–2014) reports extremely high values on war_{2l}, $war_{2l} * mean\_milex$, and $armex * war_{2l}$. Yet again, reporting no multicollinearity when excluding the interaction terms. The high correlation between the interaction variables and its components is not unexpected and cannot be remedied.

The regressions are computed with the standard OLS–method and the results can be seen in Table 5.2. It is clear that the results are not consistent across the two time periods (Column (1) and (2)). Focusing on the top five rows, $war_2 * armex$ display opposite signs across the periods. Moreover, non of the variables are significant for the first period while $mean\_milex$, war_2, and $war_2 * mean\_milex$ are significant for the second period. Another key point is that $armex$ has a positive relationship with growth in all three regressions. Lastly, regression (2) shows more significant results than regression (1).

To offer some guidance for interpretation of Table 5.2, some examples are given based on the first time period (Column (1)). An increase in $milex$ of one percentage point (e.g. going from 2% to 3% $milex$), will on average lower the growth rate of GDP/capita with 0.111 percentage points, given no wars and keeping all other variables constant. Including the effect of the interaction term $milex * war_2$ we see that at least 0.7 (= 0.111/0.156) wars during the 10–year period will induce $milex$ to have an overall positive impact on growth. Note that as the coefficients are not significantly different from zero, the given interpretations are of small value.

The results from our cross sections can also be compared to the results of Aizenman and Glick. To be able to compare, we have computed the regressions without *armex* and $armex * war_2$, which corresponds to the regression models of Aizenman and Glick, seen in the Appendix (A5). The signs of our regressions, made 6 respectively 16 years later are the same but the main variables are no longer significant comparing to the original regression in Aizenman and Glicks' paper. Furthermore, the negative impact of *milex* on growth is smaller in our regressions (–0.2 compared to –0.56).

TABLE 5.2: Cross–sectional regressions between 1995 and 2014 divided into two groups.

	(1) 1995–2004	(2) 2005–2014	(3) 1995–2014
mean_milex	–0.111	–0.223**	–0.219*
	(0.146)	(0.0770)	(0.0999)
mean_armex	0.00176	0.000330	0.00416
	(0.00446)	(0.00316)	(0.00308)
war_2	–0.00852	–0.0164**	–0.00387
	(0.00476)	(0.00566)	(0.00344)
mean_milex	0.156	0.473**	0.112
$\times war_2$	(0.147)	(0.176)	(0.0966)
armex	–0.00244	0.000935	–0.000931
$\times$ war_2	(0.00272)	(0.00216)	(0.00112)
ln_mean_capitalformation	0.0136	0.0249*	0.0263**
	(0.0104)	(0.0105)	(0.00893)
mean_pop_growth_rate	–0.0658**	–0.0215*	–0.0226*
	(0.0241)	(0.0102)	(0.00959)
ln_mean_initial_gdp	–0.00497	–0.0121***	–0.00909***
	(0.00292)	(0.00152)	(0.00150)
Constant	0.101*	0.168***	0.150***
	(0.0409)	(0.0250)	(0.0231)
Observations	65	63	77
R^2	0.390	0.658	0.552
Adjusted R^2	0.303	0.607	0.499

Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.3 Limitations of the regression models

The dataset used suffers from considerable limitations starting with the sample. For the panel regressions the same set of countries are used. Each country require at least two years of no missing values for any included variable to be included. Although every country appears on average 12.28 times, there are countries that only appear two times, bringing little explanatory power. For the cross sections the limitation appears in the form that the two different time periods do not contain the same set of countries. This is due to the availability of data across time where some countries have only reported data for one of the periods.

In spite of using all available data, less than a third of the countries in the world is covered. Countries excluded from the regressions reported either sporadicly over time or nothing at all. Moreover, the reporting can be subject to errors in measurement or not reported intentionally. The most limiting variable is *armex* which is the dataset with most missing data points. Hence, the arms transfers data stand for the bigger part of the exclusion of countries. Moreover, *armex* does not distinguish between exports to allies and commercialized trade. Hence, the security enhancing effects of exporting to allies might be diluted.

When not letting data availability steer which countries are allowed into the regressions but rather excluding outliers there is big variations in the results, indicating how sensitive the results are to the sample.

6. Discussion

6.1 Arms and economic growth

Like the previous literature has noted, the defense–growth nexus has been plagued by ambiguity given by poor quality of data, differing theoretical models and econometric methods. At the beginning of this paper, we set out to bring some clarity by testing our model specification with a range of econometric methods. We further made an attempt to expel the ambiguity brought by non–linearity and omitted variables, also pointed out by previous literature, by using interaction terms and adding *armex*. Although *armex* is rarely significant, the low correlation between it and *milex* indicates that it indeed has been an omitted variable in previous studies. However, the data availability needs improvement to establish if this really is the case. The general results are found to be very sensitive to changes in the sample of countries and econometric methods. Not only do many coefficients display different relationships between growth and themselves but several of them are persistently insignificant.

In spite of the general ambiguity of our results, the main variable *milex* is remarkably consistent across methods. It always displays a negative relationship between growth and itself and it is only insignificant in the first period of the cross sections. Conclusively, arms production seems to have adverse effects on economic growth, all else being equal. That arms production would have another effect on growth when a country experiences war, cannot be confirmed by our regressions. Consequently, we cannot accept our hypothesis.

On this basis, can we say anything about the welfare effects of arms production? Although GDP is a flawed measure of welfare, it is the best existing measure that can be compared across countries. Economic growth speaks, not always but in general for enhanced living standards. Based on the wide range of econometric methods used in our regressions, arms production seems to decrease GDP growth. Yet, we cannot claim this with certainty. If the impact on economic welfare cannot be established, the broader welfare effects can hardly be estimated.

Despite the range of econometric methods and the introduction of *armex*, the model used within the defense literature do not yield any clear results.

What should be the next steps for the study of the arms industry and the spending on defense? Possible matters that need further investigation to progress beyond the current impasse are outlined below.

6.2 The passage of time

The possibly most notable result from our regressions is the inconsistency over time. This can be seen from the cross–sectional regressions run over two separate 10–year periods. Furthermore, we are unable to confirm the previous results of Aizenman et al. (2006) when performing their regressions for later periods. Aziz and Azadullah (2017) end up in a situation similar to ours, receiving varying results depending on econometric model, when they use the same method as Aizenman et al. in the post–Cold War era. This leads us to the conclusion that time is a factor that contributes substantially to the ambiguity observed within the field.

As stated in Section 4.4, the overall trend of the relationship between military spending and wars in the world have shifted over time. Hence, the underlying assumptions about how military expenditure can be used to combat wars may have shifted as well. The rationale behind our hypothesis and by extension our model specification, is based on an explanatory model developed in a period where many wars and also high military spending was prevalent. Assuming that countries maximize growth given the information they have, the model is logical before 1991. Today's situation where the number of wars is relatively high compared to military expenditure, another model specification may be plausible. If one could end wars and increase economic growth by steering resources towards the military, why is that not happening? Possible theories are that diplomacy or building alliances are more cost effective ways of warding off security threats. If these theories are not wrong today, they most likely will be wrong in the future. Just as our predecessors, we suffer the involuntary myopia of not knowing what the future holds.

6.3 The purpose of arms production

The strict purpose of producing arms was stated in the introduction: To secure the ability to attack or defend against an enemy. But is there a single purpose of arms production? If that was the case, one could imagine that *milex* would follow number of wars much more closely in the data. This strict definition abstracts from the strong signaling effects of producing weapons. It can send a wide range of signals such as self–sufficiency, power, technological advancement, or hostility. Trading weapons can be a manner of initiating relationships or building alliances.

Also regarding the purpose of arms production, it is likely to have changed over time and depending on situation. In wartime they have most certainly been produced to kill, in peacetime they may be produced to send a signal or to uphold the geopolitical order.

So if the purpose is neither onefold nor consistent over time, the usage of arms is bound to be manifold. The definition of arm is "any device used with intent to inflict damage or harm." Nevertheless, if the armament is bought for the distinct purpose of signaling power to the rest of the world, the device is used with intent to signal power and not to inflict damage or harm.

6.4 War as a proxy for threat

The fact that war_i and the interaction terms including war_i are rarely significant in our regressions, raises suspicion about its suitability as a proxy for security threat. war_i definitely captures one form of security threats but is it good enough? Weapons are in many cases produced in anticipation of war or as a mean to avoid a conflict altogether. In these cases, a security threat that is not reflected by war_i exists. These more subtle security threats should preferably be captured by a proxy. The issue at hand is not what a security threat is, but rather if there is a way to measure security threats in a consistent and objective manner over time? No such measure is readily available today.

If war_i is not good enough, we have not measured what we set out to measure. We cannot say with certainty that arms production under security threats does not have positive effects on economic growth. Consequently, we cannot reject our hypothesis.

7. Conclusion

In line with previous literature, the results from our regression analysis are indicating that military expenditure is detrimental to economic growth. The otherwise varying and mostly insignificant results lead us to draw the conclusion that military expenditure and net arms exports, used as a proxy for arms production, during war do not seem to be determinants of growth. Consequently, we cannot confirm our hypothesis.

Our results show that either military expenditure have adverse effects on growth independent of security threats, or that there are error sources in our model specification that lead it to not correctly reflect the reality. The three error sources suggested are that the model in itself is based on a context–specific rationale, that the definition of the purpose of arms production is too narrow, and that war is not a proxy that captures security threats well enough. Further research is needed to establish if the model specification is valid over time, if arms are exclusively produced to create destruction, and if the measurement of security threats can take another approach.

In conclusion, the only way to move ahead is by taking a step back and critically examine the underlying assumptions of the defense literature. Instead of lingering around methodological questions we invite the field to acknowledge the complex linkages between the arms industry and the world that surrounds it. Not until then can we determine the true welfare effects imposed by the arms industry.

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A. Appendix

A.1 Panel data regressions

TABLE A.1: The 53 countries included in the panel data regressions between 1995–2014

Countries	
Argentina	Jordan
Australia	Kazakhstan
Austria	Malaysia
Belarus	Netherlands
Belgium	New Zealand
Botswana	Norway
Brazil	Pakistan
Bulgaria	Peru
Canada	Poland
Chile	Portugal
China	Romania
Colombia	Russia
Czech Republic	Saudi Arabia
Denmark	Singapore
Egypt	Slovakia
Finland	South Africa
France	South Korea
Germany	Spain
Greece	Sweden
Hungary	Switzerland
India	Thailand
Indonesia	Turkey
Iran	United Arab Emirates
Ireland	United Kingdom
Israel	United States of America
Italy	Venezuela
Japan	

A.2 Cross–sectional regression 1995–2004

TABLE A.2: The 65 countries included in the cross–sectional regression between 1995–2004

Countries	
Angola	Jordan
Argentina	Kazakhstan
Australia	Kuwait
Austria	Lithuania
Bahrain	Malaysia
Belarus	Netherlands
Belgium	New Zealand
Brazil	Norway
Bulgaria	Pakistan
Cambodia	Peru
Canada	Poland
Chile	Qatar
China	Romania
Colombia	Saudi Arabia
Congo-Kinshasa	Serbia
Cyprus	Singapore
Czech Republic	Slovakia
Denmark	South Africa
Egypt	South Korea
Estonia	Spain
Ethiopia	Sri Lanka
Finland	Sweden
France	Switzerland
Georgia	Syria
Germany	Thailand
Greece	Turkey
Hungary	United Arab Emirates
India	United Kingdom
Indonesia	United States of America
Iran	Uruguay
Israel	Venezuela
Italy	Zimbabwe
Japan	

A.3 Cross–sectional regression 2005–2014

TABLE A.3: The 63 countries included in the cross–section regression between 2005–2014

Countries	
Argentina	Malaysia
Australia	Netherlands
Austria	New Zealand
Belarus	Norway
Belgium	Oman
Botswana	Pakistan
Brazil	Philippines
Brunei	Poland
Bulgaria	Portugal
Canada	Qatar
Chile	Romania
China	Russia
Colombia	Saudi Arabia
Czech Republic	Serbia
Denmark	Singapore
Ecuador	Slovakia
Egypt	South Africa
Finland	South Korea
France	Spain
Germany	Sudan
Ghana	Sweden
Greece	Switzerland
Hungary	Syria
India	Thailand
Indonesia	Turkey
Iran	Ukraine
Ireland	United Arab Emirates
Israel	United Kingdom
Italy	United States of America
Japan	Venezuela
Jordan	Vietnam
Kazakhstan	

A.4 Cross–sectional regression 1995–2014

TABLE A.4: The 77 countries included in the cross–section regression between 1995–2014

Countries		
Angola	Georgia	Qatar
Argentina	Germany	Romania
Australia	Ghana	Russia
Austria	Greece	Saudi Arabia
Bahrain	Hungary	Serbia
Belarus	India	Singapore
Belgium	Indonesia	Slovakia
Botswana	Iran	South Africa
Brazil	Ireland	South Korea
Brunei	Israel	Spain
Bulgaria	Italy	Sri Lanka
Cambodia	Japan	Sudan
Canada	Jordan	Sweden
Chile	Kazakhstan	Switzerland
China	Kuwait	Syria
Colombia	Lithuania	Thailand
Congo-Kinshasa	Malaysia	Turkey
Cyprus	Netherlands	Ukraine
Czech Republic	New Zealand	United Arab Emirates
Denmark	Norway	United Kingdom
Ecuador	Oman	United States of America
Egypt	Pakistan	Uruguay
Estonia	Peru	Vietnam
Ethiopia	Philippines	Venezuela
Finland	Poland	Zimbabwe
France	Portugal	

A.5 Replicated Aizenmann and Glick–regressions

TABLE A.5: Regressions with the model specification of Aizenman et al.

	(1) 1995–2004	(2) 2005–2014	(3) 1995–2014
mean_milex	–0.0912	–0.120	–0.232*
	(0.106)	(0.102)	(0.102)
war_2	–0.00204	–0.00821	–0.00266
	(0.00730)	(0.00740)	(0.00436)
mean_milex	0.0589	0.241	0.0885
$\times$ war_2	(0.200)	(0.197)	(0.126)
ln_mean_capitalformation	0.0198	0.0242**	0.0228**
	(0.0100)	(0.00776)	(0.00794)
mean_pop_growth_rate	–0.0899**	–0.0281**	–0.0275*
	(0.0302)	(0.0105)	(0.0111)
ln_initial_gdp	–0.00678*	–0.0119***	–0.00899***
	(0.00339)	(0.00118)	(0.00150)
Constant	0.128**	0.164***	0.144***
	(0.0456)	(0.0185)	(0.0225)
Observations	87	86	87
R^2	0.266	0.635	0.485
Adjusted R^2	0.210	0.607	0.446

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$