THE RELATIONSHIP BETWEEN MILITARY EXPENDITURES AND ECONOMIC GROWTH - A CASE STUDY OF THE UNITED STATES, RUSSIA, JAPAN, INDIA AND CHINA

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Abstract: *This paper presents an exploration of the realistic relationship between national economic growth and military expenditures in 5 major states: the United States, Russia, Japan, India and China. Using statistical and case study methodologies, it examines how each country's military expenditure responded to increases in output levels and rates of growth over the period 1988~2013, proposes plausible explanations for the relationship in each country. If the experience holds true, economic growth in these countries will spur them to increase their rate of military expenditure growth and, as a result, their military capabilities. As we show, however, each country is unique, and strong economic growth by no means implies automatic expansion of military spending or capabilities.*

Keywords: *military expenditure, national output, rate of military expenditure growth, two stage least square procedure*

1. INTRODUCTION

By increasing their military expenditures, states with rapidly informational economies have the potential to develop significant military capabilities. Whether or not they choose to do so is of considerable policy relevance to other countries. In this paper, we look at the relationship between military expenditures and economic growth in four state - China, Russia, Japan, India - each of which have been experiencing rapid economic growth and holding the balance in Asia. In addition, the research contains the United States as another object of study because it has an un-neglected influence on Asian Affairs.

In statistical terms, for any given country during any given year in the sample period, the best predictor of military expenditures is the level of military expenditures in the previous year. The statistical evidence does not support generalizations about a positive relationship between output levels or output growth and military expenditures.

Further, other measures we use to proxy for other factors that might influence military decision makers - such as the number of military personnel in rival states - also do not appear to be consistently related to changes in military expenditures over time.

As a result, the states in our sample seem to have made the military expenditure decisions in response to the changes in political and economic circumstances that are not adequately captured by the statistical model by the historical data, a case study approach may provide a more believable explanations for the increases in military expenditures that took place in each country. Therefore, to answer the second question, we conduct historical case studies of the five countries, sorting our 1988~2013 sample into four time periods: 1988~1991 (the collapse of the Soviet Union); 1992~1997 (the financial crisis in Asia); 1998~2007 (American subprime mortgage crisis); and 2007~2013. Furthermore, we propose there alternative hypotheses to explain the changes of military expenditures of each country. The first of our alternative, the "ambition" hypothesis, assume that states experiencing economic growth develop an ambitious foreign policy which motivates them to increase the share of resource devoted to military expenditure. The second of our alternative, the "fear" hypothesis, posits that states increase their military spending when they perceive the enhanced threats to their security from other states. The last one, the "legitimacy" hypothesis, argue that governments develop an aggressive foreign policy and increase their military spending to achieve the support from the public when the political legitimacy is faced with domestic threats.

Of the three, only the ambition hypothesis does suggest that economic growth is the sufficient condition for the increasing of the share of their national resources devoted to military spending.

2. REVIEW OF THE LITERATURE

The major strand of the literature on the statistical relationship between military expenditures and economic growth comes from the field of development economics, where an abundance of studies have attempted to determine the influence of defense expenditures on economic development. Given the conventional view, government expenditures on national defense carry a opportunity cost, and lead to lower national output and slower rates of output growth. The theory assumes that the resource is utilized for the preparation for war and only used for war, and could be better for the welfare and economy development if put into other fields. Particularly, it assumes that it is of the first handicap for economic growth that the valuable human capital devote to military rather than civilian research and development. As a result, the assumption popular in researchers is that it is adversary that the military expenditures devote to the economic growth.

However, the empirical evidence on the relationship between economic growth and economic expenditures is widely divergent from the theory. In the statistical analysis of 44 developing countries, Benoit (1973) [1] found no evidence that military spending has a negative effect on economic growth. In fact, he pointed out that the country with high burden of defense expenditures usually had the fastest growth rate, and, by contrary, the one with low burden often had the slowest growth rate. More recently, a study by Biswas & Ram (1986) [2] looked at 58 developing countries from 1960th to 1970th, used "Feder-Ram" model and concluded that the military spending made a prominent influence on the economic growth.

A second and much smaller strand of the literature explicitly approve the impact of economic growth on military expenditures. Using the data from 1965 to 1987, Looney (1994) [4] constructed a system of equations that allow for the relative influence of resource availability, trade patterns, indigenous arms production, and other political and strategic, as well as economic variables. The model shows that economic production has a conspicuous positive influence on defense spending.

The third strand of the literature uses purely statistical analysis as well, to determine the relationship between military expenditures and growth.

Smith (1989) [7] models the relationship by an iterative approach, sets up alternatives and uses a series of specification tests to determine which best fit the data. Smith found, in an examination of British military expenditures post-1945, that military spending is a positive function of economic performance and the relative price of military and civilian goods, as well as security variables based on threat appreciation and military alliances. Beyond that, Smith found the model's applicability also fit data for France.

Chowdhury (1991) [3] took tests of the direction of statistical causality between military expenditures and growth. The result suggests that the relationship between military expenditures and economic growth cannot be generalized across countries. Moreover, there is slightly more evidence to suggest, where a relationship does seem to exist, that increases in military spending are likely to cause declines of economic growth, while increases in economic growth seem to lead to increases in military expenditures.[1]

Last, a fourth strand of the literature is dominated by an originative model of arm race developed by Richardson (1960) [6]. Studied with mathematics and statistics, Richardson assumes that the insecurity is created by the rival's military stock and the increases of military spending would happen in response to the increases of military stock of rival. Based on above, Richardson establishes simultaneous linear reaction functions to describe the change of both military stocks. Another recent model of this type is Looney (1990) [5], in which the causal factors behind the arms races in the Middle East are studied.

1 The result of the study is susceptible to the problems associated with Granger's (1969) causality estimation, namely the potential bias of the estimators because of inappropriate lag estimation, and the problems associated with errors in the source data, which Johansen (1988) discusses. Granger (1988) also points out that if military spending is adjusted highly to keep output at determined target levels given exogenous shocks, there may be no observable correlation.

Looney identifies the sequence of steps that contribute to each bilateral arms race, using a Hsiao test to different pairs of countries.[2] He identifies four possible cases:

1. Defense (A) causes defense (B)
2. Defense (B) causes defense (A)
3. Joint causality between (A) and (B)
4. No relationship.

One of the most interesting of Looney's findings is that country A may affect arms expenditures in country B even when country B does not affect country A. Another interesting finding is that the defense spending of an ally can cause the same increase as the defense expenditure of an adversary, with an even shorter lag.

Unfortunately, the variables included in the Looney's model are limited to defense expenditures, so that such factors as resource availability or economic growth are ignored.

Arms race models that incorporate economic aspects in their formulation are more interesting for our purposes. The model presented by Wolfson and Shabahang (1991) [9], for example, addresses the question, "What patterns of economic development will cause an acceleration of an arms race and increase the dangers of war?" Wolfson and Shabahang construct a model of international economic-military equilibrium and then subject it to destabilizing economic growth patterns.

Tested against the experience of the Anglo-German arms race prior to World War I, their model confirms the widely held belief that rapid growth, a high level of savings, and rapid technological progress in Germany prior to World War I prompted Britain to devote increased resources to defense right up until the two countries declared war on each other in 1914.

An important lesson from the statistical literature on the military expenditures-growth relationship is that it is difficult to generalize empirically across countries.

A number of country - and time - specific variables can influence how much a country decides to spend on military.

Further, problems of data availability and measurement contribute to the difficulty of identifying generic patterns, particularly where developing countries are concerned. Therefore some of the empirical differences between models may be simply explained by differences in researchers' choice of time period, country grouping, data averaging methodology, and lever of data aggregation.

In addition, although some models involve some political variables of government regime and social structure types, other politico-economic, socio-cultural, and historical characteristics may impact the relationship between military expenditures and economic growth and are more difficult to capture. For example, for some countries, the ability to provide a credible national defense may substitute for the procurement of other social needs as the root of national legitimacy, while for others a history of external conflicts stemming from geostrategic, ideological, religious, ethnic, or other considerations may contribute to the priority on military which is very hard to measure in statistical models.

Ideally, we would like to have been able to include the various economic, politico-economic, and sociocultural explanatory variables that theory suggests belong in a formal empirical model of the determinants of potential great power defense spending. For simplicity's sake, we ask instead two much simpler questions. First, how much of the variation on national military expenditures over time seem to be explained by movements in national output? Second, what is the direction of influence? Our results and the caveats that attend them are expanded in the next section.

3. TRENDS IN ECONOMIC OUTPUT AND MILITARY EXPENDITURES FOR FIVE POWERS

The empirical analysis is commenced with a simple comparison of tendencies for every potential great power from 1988 to 2013.

Simple graphs depict how such historical events as the collapse of the Soviet Union and the financial crisis in Asia influenced movements in defense spending and economic output.

They also provide an original test of the universality of the military expenditures-growth relationship without being subject to the data requirements of a more formal statistical analysis.

Statistical analysis is a useful method to control some of the other factors that may influence the domestic resource allocation to the military. Particularly, the system of regressions allows for the possibility that increases in state A's military expenditures, or in the size of its military stock, might influence the decision of state B how much to spend.

2 A description of the test can be found in Hsiao (1979).

We emphasize, nevertheless, that our analysis here simply involves that whether the relationship illustrated in the graphs appear robust when other variables are included. In addition, we focus on the sign rather than the magnitude of particular parameters because of the accuracy and precision of the data.

Our data consist of annual measures of military expenditures, military personnel, national output, and government expenditures for each country, excluded disturbance from price inflation and currency exchange rates for making comparison beyond countries. The measures of real national output growth are achieved by taking the difference of the ratio of current real output and lagged real output and 1. The sample period is 1988 to 2013 because of the availability of an extended and reasonably representative time series, and its practical significance of the research on the period. The data adopted in our analysis is mainly from SIPRI[3](2013) [8] to establish the scientifically, validity and coherence, included GDP, military expenditure, military personnel and government expenditure. The SIPRI data are presented in constant price US$ in 2011, according to calendar year, expect the U.S. according to financial year. Referred to the measures of national output for all states, the data are from SIPRI and it considered an inflation-adjusted output measure: a real Gross Domestic Product (GDP) series based on the average market exchange rates. The other data below from SIPRI are in the same way. In fact, SIPRI only provides military expenditure and their share of GDP; therefore, we achieved the GDP as the product of them. SIPRI also provides military expenditure per capita and the share of government spending, so we achieved the data of government expenditure in the similar way. However, for some specific reasons, the relevant data for China in 1988 and for Russia in 1991 is unavailable. And specifically, the data for Japan does not include military pensions.

In particular for China, besides the data from SIPRI, we adopted the data of military expenditure and GDP from SIPRI and Chinese Officials respectively in the statistical analysis to explore the answer to the questions. For the data from Chinese Officials, we use the same method and index from SIPRI to avoid the disturbance of price inflation and keep the coherence of data.

3.1 Cross-National Trends. Fig. 3.1, 3.2, and 3.3 illustrate the tendencies in real national output, real military expenditures and the shares of military expenditures in national output for the five states in our data sample. (All figures choose the data from SIPRI for China and the same below.) To make cross-national comparisons, we employ real output and military expenditures series that have taken a conversion to 2011 dollars except the data for 2013.

In 1988, the U.S. economy was nearly as large as the sum of the other states' economy, and twice as large as that of the most developed state in Asia, Japan (Fig. 3.1). By 2013, strong China output growth with the U.S. decelerated output growth had shrunk the differentials, but only slightly: The U.S. was twice as large as China and more than 7 times as large as India. Japan and Russia was approximately the same size as themselves. Japan has enjoyed an increase, while Russia has suffered a decline.

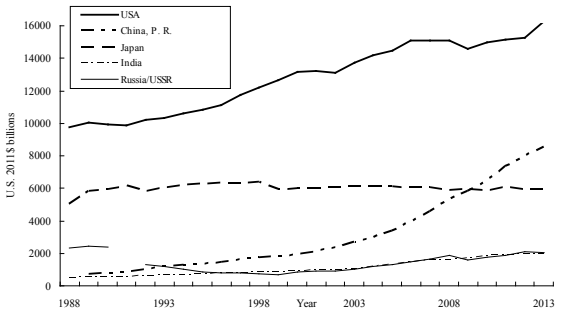

Fig. 3.1 Real Output 1988-2013, Five Powers

As depicted in Fig. 3.2, American and Russian real military expenditures have declined from 1988, especially to Russian. The American, however, began to observably increase again from "9•11" and peaked in 2010, then declined generally with the end of the war in Iraq and Afghanistan. By 2013, the United States was almost twice as large as the sum of the other states. The others mainly sustained under $100 billion, except China attained to $170 billion.

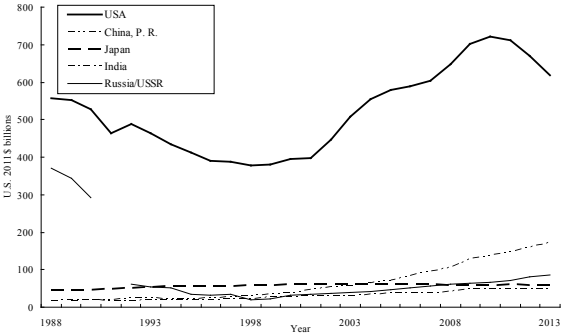

Fig. 3.2 Real Military Expenditures 1988-2013, Five Powers

3 For specific information on the sources and methods for SIPRI data, see http://www.sipri.org/research/armaments/milex/resultoutput/sources_methods.

As Fig. 3.3 illustrates, on average, the American and Russian devoted considerable more of their national output to a powerful military than the others. But after the collapse of the Soviet Union, Russian military expenditures as a share of output decreased dramatically, and all states sustained under 5 percent on the whole. The American has fallen from 5.7 percent to 3.8 percent.

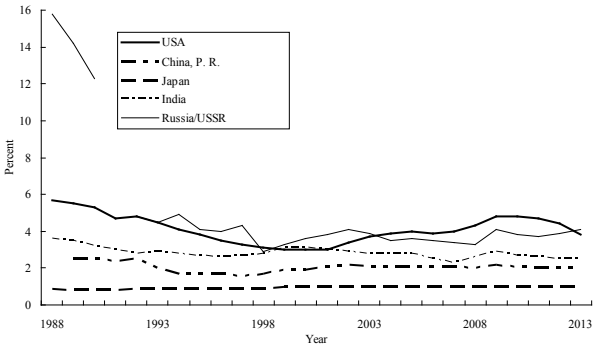

Fig. 3.3 Military Expenditures as a Share of Output 1988-2013, Five Powers

3.2 Individual State Tendency. China. As shown in Fig. 3.4 (left axis), Chinese real output has risen steadily since 1988, climbing from less than $750 billion in 1989 to more than $8500 billion in 2013, as measured in 2011 dollars. Chinese economy kept increasing and accelerated faster and faster. With economic growth, Chinese military expenditures rose strongly over the same period: from $18.3 to $171.4 billion. As shown in the figure, the growth rates of output and military expenditures were on the same levels generally.

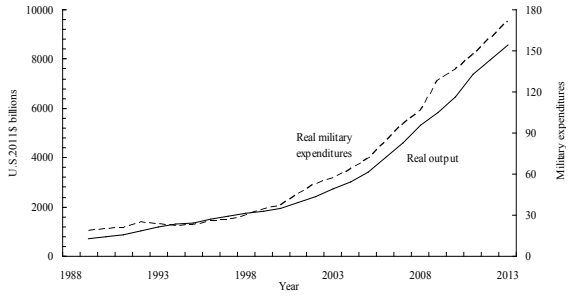

Fig. 3.4 Chinese Real output Versus Real Military Expenditures

Fig. 3.5 allows us to compare tendencies in Chinese real output (left axis) and military expenditures as a share of output (right axis) during the 1988-2013 period. As shown in the figure, military expenditures ratio began to decline from 1989 to 1996, and from then on restored to grow.

On the whole, by 2013, the share has maintained between 2 to 2.5 percent. Compared with the output growth, it is not difficult to perceive the growth of Chinese defense spending.

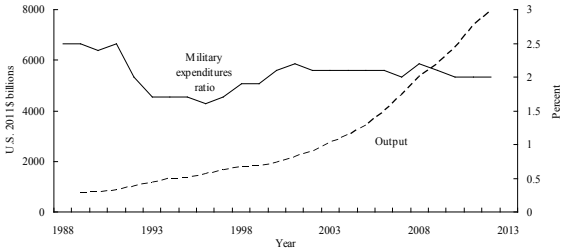

Fig. 3.5 Chinese Real Output Versus Military Expenditures-to-Output Ratio

Fig. 3.6 illustrates Chinese military expenditures to CGE ratio. Between 1989 and 2013 the share of Chinese CGE devoted to the defense also remained fairly constant and tended to make a drop-off, averaging approximately 10 percent.

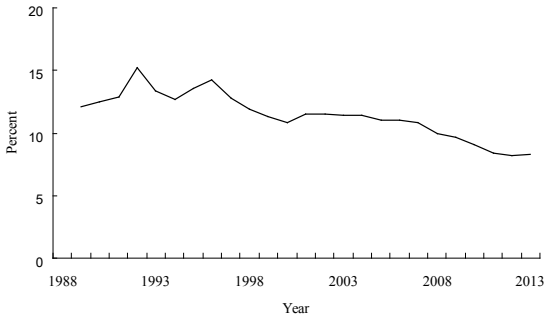

Fig. 3.6 Chinese Military Expenditures as a Share of Central Government Expenditure (CGE)

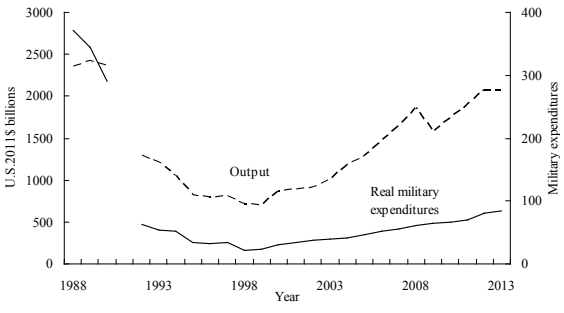

Fig. 3.7 Russian Real Output Versus Real Military Expenditures

Russia. Fig. 3.7 presents a comparison of Russian real output and military expenditures during the 1988-2013 periods. The collapse of the Soviet Union saw a dramatic drop-off in Russian output.

The military expenditures were declined sequentially. No particular trend in either series is discernible in the chaotic economic conditions of 1991. Suffered from the recession until 1999, Russian economy, as well as military expenditures, restored and began to grow. While involved in the 2007 American subprime mortgage crisis and decreased in 2007, the Russian kept growing again in 2008.

As shown in Fig. 3.8, the collapse of the Soviet Union also brought an apparent crash to the military expenditures ratio. Military expenditure shares plummeted from 12.3 to 4.8 percent, however, sustaining on the level of 4 percent.

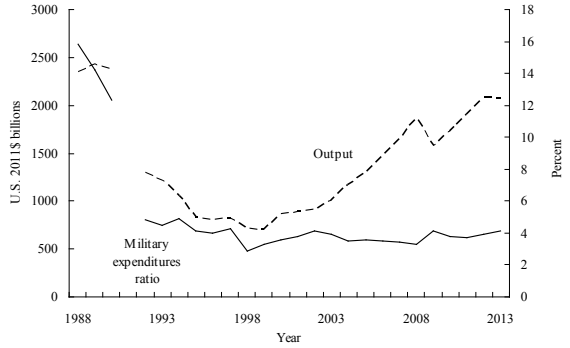

Fig. 3.8 Russian Real Output Versus Military Expenditures-to-Output Ratio

Because of the invalidity, the data of Russian military expenditures as a share of CGE from 1988 to 1997 is absent. From 1998, the share of Russian CGE devoted to the military was growing fast and peaked in 2001. After this, the share declined gradually. By 2013, however, the share of Russian CGE was more than half as large as that in 1998.

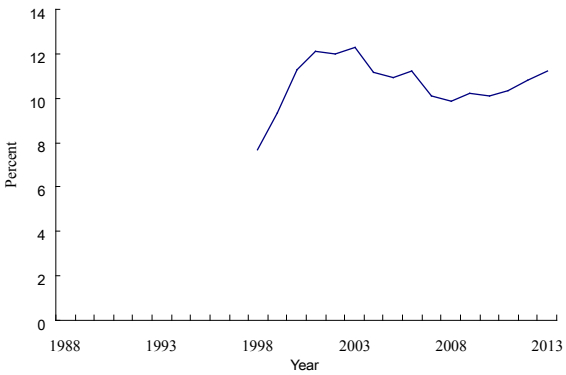

Fig. 3.9 Russian Military Expenditures as a Share of Central Government Expenditure

Japan. As indicated by Fig. 3.10, Japanese real output did not increase notably, for Japan had been developed in 1988. Influenced by the real estate bubble in 1991 and the financial crisis in Asia in 1997, Japanese economy shows two distinct declines respectively. Henceforth, Japanese economy has been in a relatively steady condition. In contrast with output, military expenditures had been increasing substantially between 1988 and 1995, while the condition of Japanese economy was not hopeful. From 1996 to 2013, both output and military expenditures have not changed significantly.

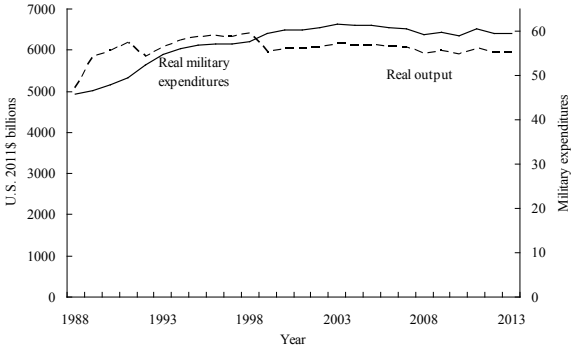

Fig. 3.10 Japanese Real output Versus Real Military Expenditures

As shown in Fig. 3.11, the change characteristic of Japanese military expenditures ratio is opposite to the change characteristic of its output. When output increased, military expenditures ratio was in stability or decline. However, when output decreased, military expenditures ratio began to grow, to keep the military expenditures stable on purpose.

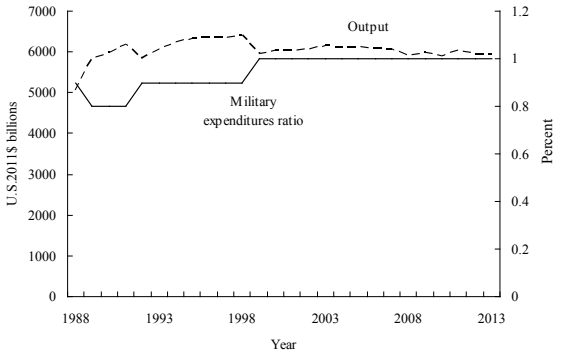

Fig. 3.11 Japanese Real Output Versus Military Expenditures-to-Output Ratio

Fig. 3.12 illustrates the Japanese military expenditures to CGE ratio.

Although the share of Japanese government resources devoted to defense slid gradually, the size of Japanese military expenditures did not shrunk, for the reason that the government expanded the CGE year after year. As shown in the figure, between 1988 and 2013, as the share of CEG, military expenditures slid from 2.8 to 2.4 percent but its volatility was not high these past few years.

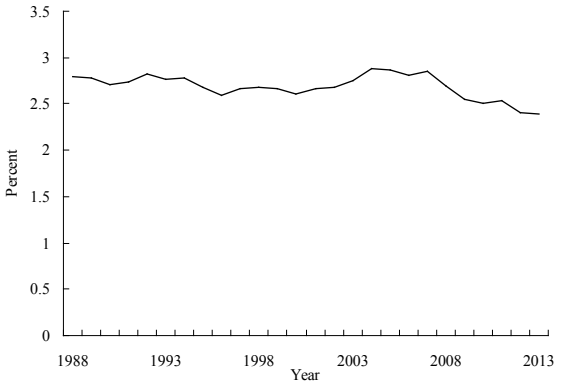

Fig. 3.12 Japanese Military Expenditures as a Share of Central Government Expenditure

India. Fig. 3.13 shows a steadily rising trend over the full sample period, while the growth rate is fluctuating. Accompanied with the output development, Indian military expenditures are expanding constantly. From 1988 to 2013, Indian economy rose from less than $500 billion to near $2000 billion, more than four times as large as that in 1988. The military expenditures boomed from $17.88 to $49.09 billion, more than twice as large as that in 1988.

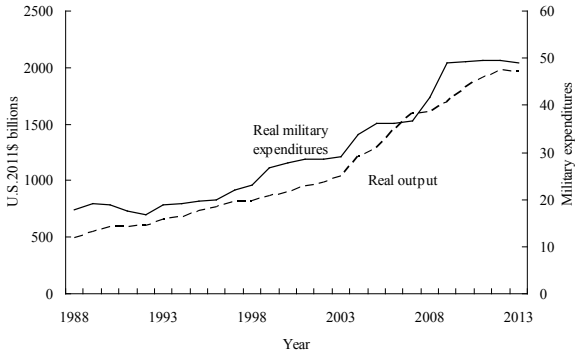

Fig. 3.13 Indian Real Output Versus Real Military Expenditures

As shown in Fig. 3.14, Indian military expenditures as a share of GDP were stable with a slight decline.

However, because of the Indian prospering economy, the size of Indian military expenditures was without any shriveling. And it is not difficult to find that Indian government attempted to maintain the ratio between 2.5 and 3 percent, a relatively stable level.

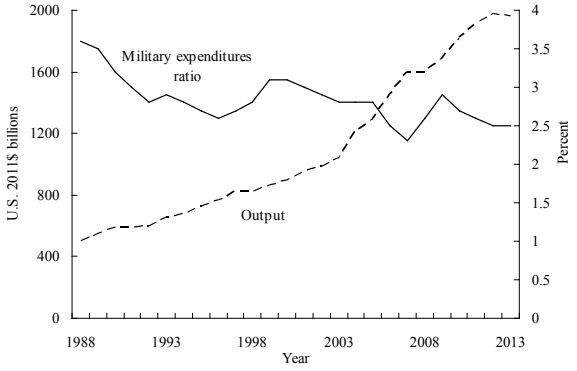

Fig. 3.14 Indian Real Output Versus Military Expenditures-to-Output Ratio

Fig. 3.15 presents a similar pattern. The share of Indian CGE devoted to defense ranged between 2.4 and 3 percent in the 1988-2013 periods, reaching a high of 2.89 percent in 2004. After that, the share was flat to down and reaching a low of 2.39 percent in 2013.

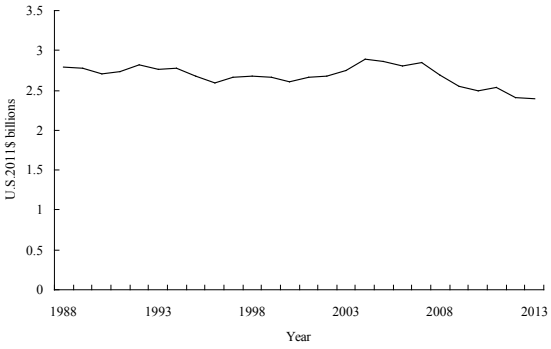

Fig. 3.15 Indian Military Expenditures as a Share of Central Government Expenditure

United States. While the U.S. economy continued to grow over the full sample period, there were two notable declines: the first was in 2002 - the first year after "9•11"; the second was in 2009, when Americans were suffering from the subprime mortgage crisis. Although American economy has undergone many crises in the 1988-2013 periods, it remained an increase trend.

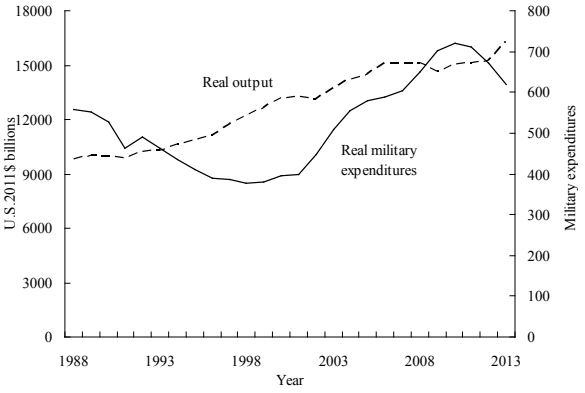

Fig. 3.16 U.S. Real output Versus Real Military Expenditures

Compared to output, the changes of American military expenditures could more explicitly illustrate the events happened in the sample period. The military expenditures were flat to down from 1988 and hit a low in 1991. Then the Gulf War broke out and the military spending rose again, peaked in 1992. The end of Kosovo War saw another decline of American military expenditures until 1998. After 2001, the "9•11" strike rendered its military spending surging and peaked again in 2010. Limited by the economy recession, the U.S. military spending has been in the down drift until 2013. Fig. 3.17 depicts a similar pattern. The changes of graphic of American military expenditures ratio resembled that of American military expenditures. Contrast with 5.7 percent in 1988, 3.8 percent in 2013 as the military expenditures ratio shows apparent decline after all.

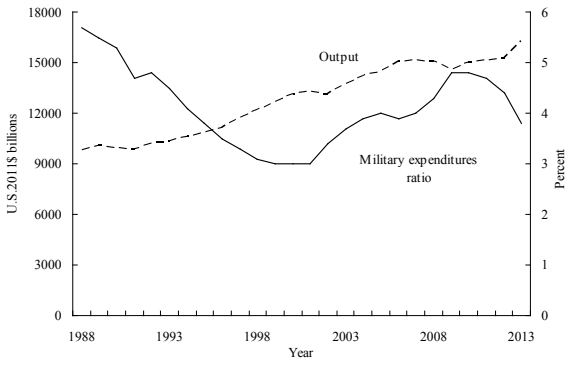

Fig. 3.17 U.S. Real Output Versus Military Expenditures-to-Output Ratio

Fig. 3.18 illustrated that the military expenditures represented more than one tenth of U.S. government resources. Despite the share of government spending devoted to defense tended to decline, it remained a high proportion.

In 1988, the ratio reached up to 15.99 percent and then slumped. By 2013, influenced by the weak economy, the ratio slid to 10 percent.

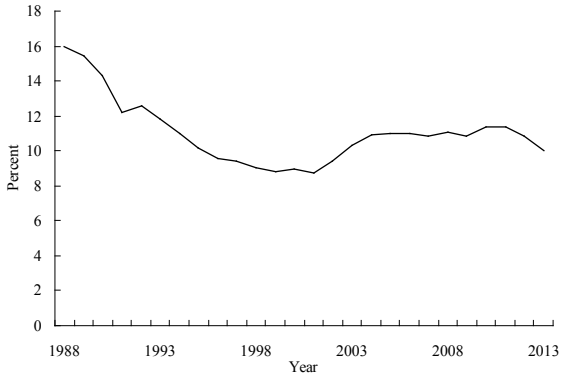

Fig. 3.18 U.S. Military Expenditures as a Share of Central Government Expenditure

4. STATISTICAL ANALYSIS OF MILITARY SPENDING AND ECONOMIC OUTPUT

The graphical analysis above illustrates that as the economies grew in peacetime, the five states in our sample did generally attempt to match the growth by increasing their military expenditures.

What graphical analysis cannot address us is whether such patterns should be cause for concern. In instance, a benign interpretation of a positive relationship between economic growth and military expenditures is that people believe they have more to protect when the state becomes wealthier.

In accordance with the interpretation, the increase of military expenditures caused by economic growth is defensive. A less reasonable interpretation is that greater wealth allows states to pursue aggressive foreign policy targets considered unapproachable before.

For example, if these foreign policy targets include territorial expansion at the expense of neighbors, rapid economic growth should be paid more attention by international community of states.

In the analysis that follows, we attempt to control for some of the factors other than expansions and contractions in the economy. These may have influenced the allocation of government resources toward the military in our five sample states. Furthermore, we allow for the possibility that changes in the growth rate of output might influence defense spending decisions.

Model. In this model, we examine how the respective dependent variables for each state are affected by changes in three explanatory variables: the level of real national output, the growth rate of real national output and the other states' real military expenditures. We allow for a simultaneous decision-making process and assumed that defense policymakers contemporaneously observe each other's defense spending decisions and respond accordingly. Lagged values of the dependent variable are also included in each equation in the belief that adjustments to military expenditures are influenced by the level (or share) of existing allocations. Such a method has an advantage in that it allows increases in spending by both friends and rivals to influence spending decisions. The null hypothesis is that changes in real economic output and real economic growth do not affect military spending decisions.

The system of simultaneous equations we estimate for the model is

$$M_{it} = C_i + M_{it-1} * B_{Mi} + \sum_j (OUTPUT_{it-j} * B_{Oij} + GROWTH_{it-j} * B_{Gij}) + \sum_{k \neq i} M_{kt} + U_{it},$$

where represents real military expenditures or expenditure shares respectively for China, Russia, Japan, India, and the United States.

The variables (constant terms), *OUTPUT* (national real output measures), *GROWTH* (national real output growth measures) all take the same form.

We assumed that the vector of disturbance terms, *U*, is correlated across states as well as across time periods[4]. This assumption derives from the fact that many external events (for instance, the "9•11"terrorist attacks) leading to unplanned military expenditures are likely to have affected all four of the states in our sample contemporaneously.

In this model, we consider two possible decision variables: real military expenditures and military expenditures as a share of output. The subscripts *i* and *k* are state indexes, *t* and *j* are time indexes; for the purposes of our estimation, *j* is set to 1.

4 That is, both Cov(U_{it}, $U_{it\text{-}1}$) and Cov(U_{it}, U_{ik}) are nonzero, implying that the structure of the time dependence is first-order auto regressive (AR(1)) and that disturbances are that disturbances are contemporaneously correlated across countries

We employ a two stage least square procedure using further lags of the explanatory variables as instruments for . This procedure does not require the absence of missing values in the data. The sign and significance of the parameter estimates for each state are reported in Table 3.1 through 3.5. The Table 3.1 to 3.5 make up the part 1, derived from the data by virtue of SIPRI, and the Table 3.6 to 3.10 make up the part 2, derived from the data by virtue of Chinese Officials.

Part 1. China. Table 4.1 presents the findings for China. The signs of the estimated parameters vary across model specifications, and no coefficient estimate is significant across both specifications. The lagged military expenditure variable appears to be positive and significant when the dependent variable is real military expenditures, but it becomes insignificant when the dependent variable is the military expenditures-to-output ratio. There is little support for a positive relationship between output and military expenditures. The sign of the coefficient estimate for lagged Chinese real output is not robust across model specifications, and neither it nor output growth is significant in either specification. Japanese military expenditures and the U.S. military expenditures variables are positive as predicted, while only when the dependent variable is the military expenditures-to-output ratio for Japanese military expenditures variable.

Table 4.1. China: Sign and Significance of Model Parameter Estimates

China	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	No	-	No
Lag Depend	+	Yes	+	No
Lag Output	+	No	-	No
Lag Growth	-	No	-	No
Jap. Military expenditures	+	No	+	Yes
U.S. military expenditures	+	No	+	No
Adjusted R^2	0.96		0.54	

Russia. The model does not do much better at explaining patterns in Russia, as shown in Table 4.2.

The explanatory power of the model is universally poor: none of the coefficients are statistically significant. However, Durbin-Watson statistic is quite high across both specifications, suggesting there is no auto correlation in the residuals.

Table 4.2. Russia: Sign and Significance of Model Parameter Estimates

Russia	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	No	-	No
Lag Depend	-	No	+	No
Lag Output	+	No	+	No
Lag Growth	-	No	-	No
U.S. military expenditures	-	No	-	No
Adjusted R^2	0.73		-0.21	

India. For India, the model has much greater explanatory than that for Russia. As shown in Table 4.3, lagged military expenditures and U.S. military expenditures are positive and significant in the real military expenditures specification. Although statistically significant, the coefficient on real output is negative in the military expenditures-to-output ratio.

Table 4.3. India: Sign and Significance of Model Parameter Estimates

India	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	Yes	+	No
Lag Depend	+	Yes	-	No
Lag Output	+	No	-	Yes
Lag Growth	-	No	-	No
Chi. military expenditures	-	No	-	No
U.S. military expenditures	+	Yes	+	No
Adjusted R^2	0.98		0.22	

Table 4.4. Japan: Sign and Significance of Model Parameter Estimates

Japan	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	+	Yes	+	No
Lag Depend	+	Yes	+	Yes
Lag Output	-	Yes	+	No
Lag Growth	+	No	+	No
Chi. military expenditures	+	No	+	Yes
Adjusted R^2	0.88		0.82	

Japan. Japanese results from the model are presented in Table 4.4. Lagged military expenditures are now the best predictor of current military expenditures, with a robust and significant positive relationship. However, real output is negatively and positively related to Japanese military expenditures and the military expenditures-to-output ratio respectively. The Chinese military expenditures variable is positive as predicted.

Table 4.5. United States: Sign and Significance of Model Parameter Estimates

United States	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	No	-	No
Lag Depend	+	Yes	+	Yes
Lag Output	+	No	+	No
Lag Growth	-	No	+	No
Chi. military expenditures	+	No	+	Yes
Jap. military expenditures	+	No	-	No
Adjusted R^2	0.65		0.75	

United States: As shown in Table 4.5, past military expenditures once again provide most of the explanatory power for current military expenditures. Real output and real output growth, however, have no significant relation to either real military expenditures or the military expenditures ratio. In addition, Chinese military expenditures variable is positively related to U.S. military expenditures in the military expenditures-to-output ratio.

Part 2. China. As reported in Table 4.6, the model does a relatively poor job of explaining Japanese military expenditures. Past military expenditures are both positively related to current expenditures whether measured in real terms or as a ratio to national output, and significant measured in real output. But no other coefficient estimates are statistically significant. There is no evidence of higher-order serial correlation in the errors.

Table 4.6. China: Sign and Significance of Model Parameter Estimates

China	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	+	No	-	No
Lag Depend	+	Yes	+	No
Lag Output	-	No	-	No
Lag Growth	-	No	-	No
Jap. military expenditures	-	No	+	No
U.S. military expenditures	-	No	+	No
Adjusted R^2	0.99		0.76	

Russia. The regression results for Russia are presented in Table 4.7. The model is not good at explaining patterns in Russia. Coefficients appear to have no statistically significant relation to real military expenditures. This is consistent with the Part 1 results. U.S. military expenditures have no significant explanatory power as well.

Table 4.7. Russia: Sign and Significance of Model Parameter Estimates

Russia	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	No	-	No
Lag Depend	+	No	+	No
Lag Output	+	No	+	No
Lag Growth	-	No	+	No
U.S. military expenditures	-	No	-	No
Adjusted R^2	0.81		-0.84	

India. Table 4.8 reports the results for India. In contrast to China, Japan, and the United States, movements in past military expenditures de mot seem to explain current movements. In the military expenditures, real output is positive while real output growth is negative. Both of them are significant. As we anticipated, U.S. military expenditures variable is positive and significant in the military expenditures.

Table 4.8. India: Sign and Significance of Model Parameter Estimates

India	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	No	+	No
Lag Depend	+	No	+	No
Lag Output	+	Yes	-	No
Lag Growth	-	Yes	-	No
U.S. military expenditures	+	Yes	+	No
Adjusted R^2	0.98		0.41	

Japan. Table 4.9 presents the econometric findings for Japan. As shown, real military expenditures match the model much better than another specification. In real military expenditures, lagged military expenditures are significant and positive, while national real output is negative. The Chinese military expenditures, however, show significant and positive in the military expenditures-to-output ratio.

Table 4.9. Japan: Sign and Significance of Model Parameter Estimates

	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	+	Yes	+	No
Lag Depend	+	Yes	+	No
Lag Output	-	Yes	-	No
Lag Growth	+	No	+	No
Chi. military expenditures	+	No	+	Yes
Adjusted R^2	0.87		0.72	

Table 4.10. United States: Sign and Significance of Model Parameter Estimates

	Dependent Variables Is:			
	Real Military Expenditures		Military Expenditures Ratio	
Variable	Sign	Signif	Sign	Signif
Constant	-	No	-	No
Lag Depend	+	Yes	+	Yes
Lag Output	+	No	+	No
Lag Growth	-	No	+	No
Chi. military expenditures	+	No	+	Yes
Adjusted R^2	0.83		0.82	

United States. For the United States, similarly as Part 1, the United States of Part 2 continue to have a significant and positive relationship to lagged military expenditures, while real output and real output growth have no significant relation to either real military growth or the military expenditures ratio. However, Chinese military expenditures are positively and significant related to U.S. military expenditures in the real military expenditures ratio specification.

5. CONCLUSION

Overall, both our graphical and statistical analysis indicates that the relationship between military expenditures, economic output and economic output growth varies over time and across countries. Further, our statistical results are not robust to deferent model specifications. In terms of explanatory power, there is no consistent pattern across countries. For most states, the strongest predictor of current military expenditures is military expenditures in the immediate past, whether these expenditures are measured in levels or as a share of output. While it is un surprising that current military expenditures decisions are heavily influenced by decisions made in the past, this fact sheds little light on why decisions were made in the first place.

Our results indicate that the statistical evidence for a strong relationship between the five states military expenditures and national output during the 1988-2013 sample periods is less than overwhelming. Certainly no conclusive evidence as to the direction of causality between the two has been presented.

While it seems plausible that Japan might respond positively to increases in Chinese military spending, for example, it seems much less plausible that Russia actually reduced its military spending in response to U.S. spending increases.

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