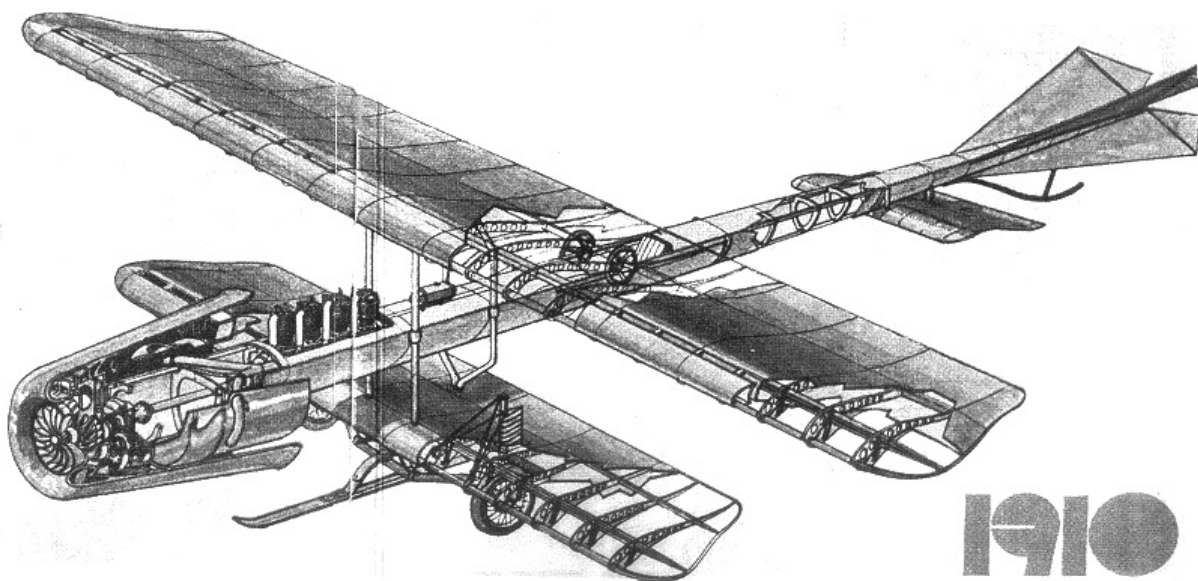


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AN EMPIRICAL RESEARCH ON THE RELATIONSHIP BETWEEN DEFENSE SPENDING AND AGGREGATE OUTPUT OF CHINA

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Abstract: *In this article the effect of defense spending on aggregate output is discussed. Recent publications in this area are reviewed and new additional evidence is provided. In the period of 1952-1978, the findings reported here imply that a rise of defense spending should bring significant increase in China economy; in the period of 1978-2009, a rise of defense spending should bring significant decrease in China economy. Therefore defense spending matters. But in the long-run period 1952-2009, a rise of defense spending should bring little decrease in China economy.*

Keywords: *defense spending, aggregate output, interest-rate augmented Keynesian cross-model, cointegration*

1. INTRODUCTION

The question of defense spending and its effect on growth has received considerable attention in the defense literature. The studies published in recent years, however, do not yield a coherent conclusion. Some studies indicate that defense spending has a positive effect while others reveal no effect and yet others indicate a negative effect on output. More interestingly, Smith and Tuttle (2008) found that real output played an important role in determining real defense spending in the US, but found little evidence supporting a positive or negative effect in real output from defense spending changes. In contrast to Atesoglu (2002), they did not find support for his conclusion that military spending promotes real aggregate output. But in his latest paper, Atesoglu (2009) argued back that defense spending has a positive effect on aggregate output. To contribute to the existing pool of literature, the purpose of this article is to study the relationship between defense spending and aggregate output in China.

There have been some literatures focusing on the relationship between defence spending and economic growth in China.

Chien-Hsun Chen (1993) examines the causal relationship between defence spending and economic growth in China over the period 1950-1991.

The results show that defence spending is not cointegrated with the real economic growth rate, implying the lack of any long-run equilibrium relationship between the two variables. In addition, Granger causality tests indicate causal independence between the two variables. (D→E)

Abdul M.M. Masih & Rumi Masih & Mohammad S. Hasan (1997) examine empirically the causal relationship between defence spending and economic growth in China. The results indicate a positive unidirectional causality flowing from defence spending to economic growth. They broadly indicate that defence spending and economic growth did share a common trend over the sample period under analysis, but it was the former which stimulated the latter.

Moreover, it is defence spending that has a much more perceptible and prolonged effect on economic growth, giving rise to implications that although expenditure on defence may have been politically motivated, over the long-run this spending did play a significant indirect role in enhancing the growth potential of this, for many years, closed-door economy. (D→E)

Yemane Wolde-Rufael (2001) challenges the claims of a previous article which tested the long-run relationship between economic growth and defence spending for China for 1950-1991 and stated that the two series were integrated of the same order but not Granger-causally related to each other in any direction.

An empirical research on the relationship between defense spending and aggregate output of China

There is a unidirectional Granger causality running from defence expenditure to economic growth. (D→E)

Chung-Nang Lai & Bwo-Nung Huang & Chin-Wei Yang (2005) employs both linear and non-linear models to investigate the relationship between national defense spending and economic growth for China. Using data from 1953-2000 on defense spending, GDP, import, export and capital, they find that China's national defense is found to lead economic growth. (D→E)

In the case of China, Rudra Prakash Pradhan (2010) finds bidirectional causality between economic growth and public debt in China, and unidirectional causality from defense spending to economic growth in China. (D→E)

Why are there so many different results on the relationship between defense expenditure and economic growth? Dunne, J. Paul and Smith, Ron (2010) have given us good answer, we cite their words here.

“A large literature has used tests for Granger (1969) non-causality, GNC, to examine the interaction of military spending with the economy. Such tests answer a specific though quite limited question: can one reject the null hypothesis that one variable does not help predict another? If this null is rejected, there is said to be Granger causality, GC. Although the limitations of GNC tests are well known, they are often not emphasized in the applied literature and so may be forgotten.” “First, the tests may not be informative about the substantive issue, the interaction of military expenditure and the economy. The difficulty is that Granger causality, incremental predictability, does not correspond to the usual notion of economic causality. To determine the relationship of the two notions of causality requires an identified structural model. Second, the tests are very sensitive to specification. GNC testing is usually done in the context of a vector auto regression, VAR, and the test results are sensitive to the variables and deterministic terms included in the VAR, lag length, sample or observation window used, treatment of integration and cointegration and level of significance. Statistical criteria may not be very informative about these choices.

Third, since the parameters are not structural, the test results may not be stable over different time periods or different countries.”

The studies summarized above suggest that one should be careful when making declarations about the effect of defense spending on aggregate output. The results as a whole seem to indicate that findings are sensitive to the models, econometric methods, and estimation periods employed. In this paper we will borrow model from Atesoglu (2009) to discover the relationship between defense spending and its effect on growth in China.

2. THE MODEL

Borrowing from Atesoglu (2002), the traditional Keynesian cross is defined as:

$$Q_t = C_t + I_t + X_t + M_t + G_t \quad (1)$$

Where Q_t is real GDP, C_t is real consumption spending, I_t is real investment, X_t is real net exports, M_t is real defense (military) spending, and G_t is real non-defense (non-military) government spending. Consumption is defined as some level of autonomous consumption (a) plus the marginal propensity to consume (b) times disposable income:

$$C_t = a + b(Q_t - T_t) \quad (2)$$

Where T_t is defined as real taxes, and equals:

$$T_t = n + gQ_t \quad (3)$$

Investment is a negative function of real interest rates:

$$I_t = n + gQ_t \quad (4)$$

Real net exports are a negative function of real output and real interest rates:

$$X_t = z - mQ_t - nR_t \quad (5)$$

The reduced form solution for real output, including a stochastic error term, is:

$$Q_t = \alpha + \beta M_t + \delta G_t - \lambda R_t + u_t \quad (6)$$

where

$$\alpha = (a - nb + e + z) / (1 - b(1 - g) + m),$$

$$\beta = \delta = 1 / (1 - b(1 - g) + m)$$

$$\text{and } \lambda = (f + n) / (1 - b(1 - g) + m).$$

As noted by Atesoglu (2002), this model differs from the normal Keynesian cross in its treatment of R_t (investment normally modeled as a function of nominal interest rates), while net exports are normally assumed to depend only on real income, versus real income and real interest rates as in this model.

3. THE EVIDENCE OF CHINA

In the case of China, its economy is transforming from planned economy to market economy. There are two different periods since 1949: closed-door economy before 1978 and opened-door economy after 1978. While GDP increases 8.5% each year since 1952 to 2009, the average GDP growth rate is 5.9% before 1978 and 10.5% after 1978.

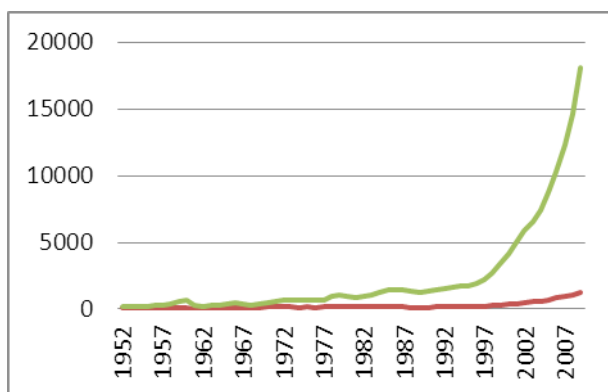


Fig 1 GDP, Non-defense Government Spending and Defense Spending

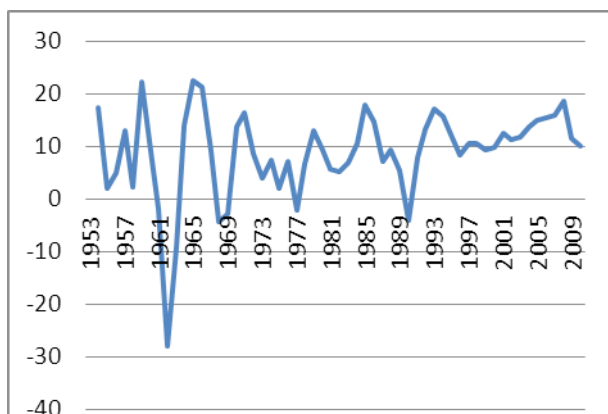


Fig 2 Growth Rates of GDP

Table 1 Growth Rates of GDP, Defense Spending and Non-Defense Government Spend

	1952-2009	1952-1978	1978-2009
growth rate of GDP	8.5%	5.9%	10.5%
growth rate of Defense Spending	5.2%	3.4%	5.8%
growth rate of Non-Defense Government Spending	8.9%	7.6%	9.7%

From Table 1 we can see that growth rates of defense spending are less than those of GDP and non-defense government spending.

Table 2 Defense Spending as a Share of GDP and Government Spending

	1952-2009	1952-1978	1978-2009
Defense Spending as a share of GDP	1.7%	5.4%	1.4%
Defense Spending as a share of Government Spending	9.0%	18.5%	8.0%

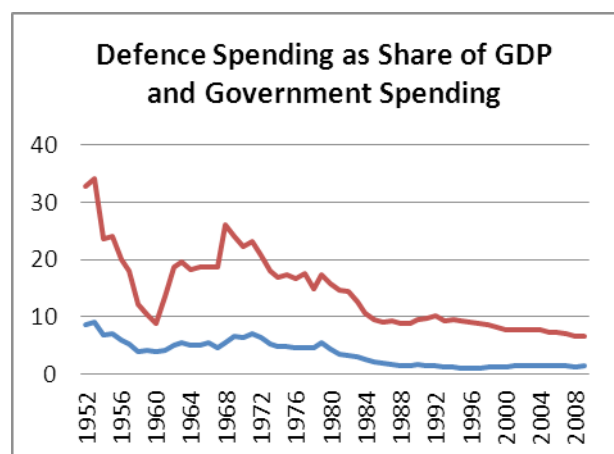


Fig 3 Defense Spending as Share of GDP and Government Spending

4. METHODOLOGY AND RESULTS

4.1 Data The annual data used come from two sources. Gross Domestic Product (GDP), aggregate defense (military) spending (ME), and aggregate non-defense (non-military) spending (GE) are available from the China Statistical Yearbooks.

The real interest rate (R) used are one-year deposit rates from People's Bank of China. Finally, real GDP, defense spending, and non-defense spending variables are transformed into natural log levels, denoted respectively by LGDP, LME, LGE.

4.2 Data properties Before estimating the parameters of equation (6), the data generating process for each variable is considered. For this purpose, the Augmented Dickey-Fuller (ADF) unit root test was made. The ADF test results indicate that series are likely to be first-order integrated and they are difference stationary. These findings suggest that there may be a long-run equilibrium relation among these non-stationary variable in equation (6). If these variables move systematically together over time, they may be cointegrated. Cointegration analysis is concerned with estimation methods that utilize the information about both long run and short run dynamics.

There is some evidence that the Johansen method is superior to other methods testing for cointegration. Accordingly, in this paper, the Johansen method is used for testing cointegration and estimating the coefficients of equation (6).

Results obtained with the Johansen method for equation (6) are

$$Q_t = 1.050 - 0.051M_t + 1.126G_t - 0.004R_t \quad (7)$$

(-0.360) (11.514) (-0.528)

where sample is 1952–2009, a deterministic trend is included for the data, and lag interval: 1 to 4. The lag interval selected is the conventional lag interval adopted in macroeconomic models.

Empirical results detailed above uniformly indicate a cointegration relation among the variables in equation (6). Signs of the estimated cointegration coefficients in equation (7) are consistent with those required theoretically by equation (1), and, according to their standard errors reported in parentheses under each coefficient, the estimated coefficients are statistically significant.

It is seen that a 1% rise in real defense spending would lead to about a 0.05% decrease in real GDP. A 1% rise in real non-defense government spending should bring about a 1.13% rise in real GDP. A 1% rise in the real interest rate, representing the monetary sector, leads to about a 0.004% decrease in real GDP.

We also us another two group data to test: the first is 1952-1978 and the second is 1978-2009. The results are the following.

1952-1978:

$$Q_t = 2.423 + 0.468M_t + 0.493G_t - 0.007R_t$$

(7.772) (8.178) (-1.786)

It is seen that a 1% rise in real defense spending would lead to about a 1% decrease in real GDP. A 1% rise in real non-defense government spending should bring about a 1.76% rise in real GDP. A 1% rise in the real interest rate, representing the monetary sector, leads to about a It is seen that a 1% rise in real defense spending would lead to about a 0.468% increase in real GDP. A 1% rise in real non-defense government spending should bring about a 0.493% rise in real GDP. A 1% rise in the real interest rate, representing the monetary sector, leads to about a 0.007% decrease in real GDP.

Table 3 Cointegration Test Results

Number of Cointegrating Vectors	Trace Statistic	0.05 Critical Value
None	58.52325	40.17493
At most 1	23.58075	24.27596
At most 2	11.00469	12.32090
At most 3	1.324764	4.129906

The empirical results reveal that defense spending has a significant and positive effect on real GDP in China.

1978-2009:

$$Q_t = 1.449 - 1.001M_t + 1.759G_t - 0.001R_t$$

(-4.674) (10.724) (-0.131)

It is seen that a 1% rise in real defense spending would lead to about a 1% decrease in real GDP. A 1% rise in real non-defense government spending should bring about a 1.76% rise in real GDP. A 1% rise in the real interest rate, representing the monetary sector, leads to about a 0.001% decrease in real GDP. The empirical results reveal that defense spending has a significant and negative effect on real GDP in China

	1952-2009	1952-1978	1978-2009
elasticity of defense spending	-0.05%	0.468%	-1%
elasticity of non-defense government spending	1.13%	0.493%	1.76%
elasticity of interest rate	-0.004%	-0.007%	-0.001%

5. CONCLUSION

The empirical results detailed in this paper are in conformity with those reported by Dunne, J. Paul and Smith, Ron (2010). In the period of 1952-1978, the findings reported here imply that a rise of defense spending should bring significant increase in China economy; in the period of 1978-2009, a rise of defense spending should bring significant decrease in China economy. Therefore defense spending matters. But in the long-run period 1952-2009, a rise of defense spending should bring little decrease in China economy.

The tentative conclusion that follows is that the effects of defense spending in China appear to be sensitive to the various models, econometric techniques and mostly, the sample periods employed.

ACKNOWLEDGMENTS

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An empirical research on the relationship between defense spending and aggregate output of China

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THE STUDY ON THE TRANSACTION COST OF INTELLECTUAL PROPERTY OF NATIONAL DEFENSE

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***Abstract:** In the field of the intellectual property of national defense, the price analysis has made periodical development. However, the cost analysis which is corresponding to the price analysis is in severe shortage. The paper selects the transaction link of the intellectual property of national defense as the cutting point. Moreover, the author makes a brief analysis of the transaction cost of the intellectual property of the national defense from three perspectives of the necessity of the analysis of the transaction cost of the intellectual property of national defense, the reason of the occurrence of transaction cost of the intellectual property of national defense and the independent variable of the transaction of the intellectual property of national defense.*

***Keywords:** intellectual property of national defense; transaction cost; proprietary; sunken cost*

1. INTRODUCTION

Price theory and cost theory are the two indispensable parts in the theory of commodity exchange. Studies show that in the field of the intellectual property of national defense, the golden ratio method is the most operable through the price analysis of pricing trial. However, the theoretical achievements of cost analysis in the field are in comparatively great shortage. The paper selects the transaction link of the intellectual property of national defense as the cutting point. Moreover, the author makes a brief analysis of the transaction cost of the intellectual property of the national defense from three perspectives of the necessity of the analysis of the transaction cost of the intellectual property, they are namely: national defense; the reason of the occurrence of transaction cost of the intellectual property of national defense; and the independent variable of the transaction of the intellectual property of national defense.

2. THE NECESSITY OF THE ANALYSIS OF THE TRANSACTION COST OF THE INTELLECTUAL PROPERTY OF NATIONAL DEFENSE

In terms of the form of the right, it is rooted in laws, which is also a systemized “product”. However, if dig it much deeper, we will find the root lies in the systemized and rationalized demands of social life. Every individual in the same common world has his or her own unique demands. Conflicts of interests occur inevitably. If we take no actions to solve the conflicts, the social life will definitely in disorder. Therefore, the “product set” which is used to manage social orders comes into being, which integrates the diversified “product sets” of the power or rights that are considered as rational and legal and entitled to the individuals. The intellectual property of national defense belongs to the intellectual rights. Therefore, it is also a member of the big family of the “product set”.

The study on the transaction cost of intellectual property of national defense

As for the intellectual property of national defense, it is a right that the nation and the national defense can enjoy the intelligence accomplishment made by the national intelligence party on their own; or they can enjoy the accomplishment jointly.

As a branch of rights, it requires for cost payment not just because the essence of rights is the dependence on the government.

Moreover, unlike other rights, the property right party of the intellectual property of national defense also includes our nation.

As a result, it is more complicated and necessary to conduct cost analysis.

Speaking of cost, it seems to be associated with certain theories of accounting. Nevertheless, just as what the author of Costs of Rights points out in page 9, i.e. "...it is only related to the essence of legal rights rather than an elaborate study on finance".

The intellectual property of national defense is a right, which means freedom. As for freedom, it is just as what the author of Costs of Rights points out in page 153, i.e. "...it does not mean that freedom does not need the government; on the contrary, an active government provides the conditions for freedom."

If there is no compulsory interference of the government or as the deterrent for the potential right-invaders, right or freedom may encounter invasion. The right depends on the ability of government to absorb and allocate the resources.

Besides, to add up with the dependence due to "an active government provides the conditions for freedom" requires for certain cost payment.

In December 2009, the leading group ready to implement the intellectual property of national defense issued Implementation Plan of the Strategy of the Intellectual Property of National Defense, which ensures to establish perfect intellectual property of national defense, create the environment for the operation of the intellectual property system of national defense normatively, improve the quantity and quality of the intellectual property of national defense, etc.

The plan requires that the implementation of the strategy of the intellectual property of national defense shall make some innovation and breakthrough on the system construction to further update the ownership system of the intellectual property conducive to innovation, the utilization system of the intellectual property which is helpful to the transfer and application of technology and the management system of the intellectual system beneficial to motivate the development of national defense technology and weaponry equipment.

The establishment of the confidential and disclosure system of the intellectual property of national defense, enhancement of the system and measures of the application of the intellectual property of national defense in the civilian area, encouragement of the system and measures of the application intellectual property in the civilian area in the national defense area, the establishment of the system of treating disputes of the intellectual property of national defense, the construction of the intellectual property institutions of national defense, the construction of the information platform of the intellectual property of national defense, the establishment of the agency service system of the intellectual property of national defense, the development of the legal system of the intellectual property of national defense, the ownership and interest allocation system of the intellectual property of national defense and other specialized tasks in the plan are all major supports for the establishment of standardization of the transaction environment of the intellectual property of national defense.

In August 2011, the 19th specialized task in the strategic implementation of the intellectual property of national defense, i.e. "the right ownership and interest allocation system of the intellectual property of national defense" pointed out that through pricing trial, the golden ratio is the most operable when signing the national defense contract on the condition that it meets the requirements of the national defense and forced transaction pricing and by adjusting technology adversely to achieve the price balance between the buyer and seller.

Besides, the golden ratio method can well demonstrate the value of the intellectual property of national defense.

It symbolizes that price analysis has achieved periodical progress in the field of intellectual property of national defense.

In addition, cost and price are two indispensable parts in the field of exchange.

However, in the field of intellectual property of national defense, cost analysis is comparatively in shortage.

Therefore, it is necessary to carry out multi-dimensional analysis on the cost. That's also the reason why the author writes the paper.

3. THE REASON OF THE OCCURRENCE OF TRANSACTION COST OF THE INTELLECTUAL PROPERTY OF NATIONAL DEFENSE

In essence, wherever the exchange activity happens, there is transaction cost. The concept of transaction cost was first introduced to the economic analysis by the New Institutional Economics besides traditional production cost.

The transaction cost of the intellectual property of national defense refers to the cost needed to complete the transaction of intellectual property of national defense, that is, all the time cost and currency cost in the transaction process, including the disclosure of the cost of the information disclosure, consultation, discussion, negotiation, contract implementation and supervision, solutions of disputes, relief and other activities.

The denominator of "New Institutional Economics", Oliver Williamson, the Nobel Economic Prize Winner in 2009 held the opinion that the market failure phenomenon due to the mutual impact of human beings and transaction environment added to the difficulty of transactions and generated the transaction cost.

The author agrees Williamson's opinion. Furthermore, the author thinks that in the transaction field of the intellectual property of national defense, the occurrence of transaction cost is attributed to the following several factors:

3.1 The proprietary of the intellectual property of national defense. From the essence of capital, it can be used for different purposes and by different users on the condition that it does not sacrifice the production value.

However, due to the particularity of the intellectual property of national defense, many kinds of intellectual properties of national defense cannot be used for other purposes except national defense.

The transaction process is too exclusive with few transaction objects. Therefore, we can call it Small Numbers.

Besides, the proprietary and small numbers may result in the Sunken Cost of the investment cost of the intellectual property of national defense. The purpose of the transaction is "one-off"; the sunken cost becomes the transaction cost.

3.2 The complexity of the transaction environment of the intellectual property of national defense. The intellectual property of national defense serves for the national defense.

Because of the unpredictability and various changes in the environment factors, the transaction parties take into consideration the uncertainty and the complexity in the future in the transaction process, which increases the difficulty of the transactions and adds to a huge amount of bargaining costs in signing the contract in the transaction process (The transaction contract of the intellectual property of national defense). What accompanies the high risk is the high price. Moreover, in order to reduce the high price, time, labor and other costs are also in great consumption. All these types belong to transaction cost.

The study on the transaction cost of intellectual property of national defense

3.3 The restriction of the subjective cognition of the transaction parties of the intellectual property of national defense.

The participants in the intellectual property transaction of the national defense seek for the maximization of the profits, thus generating the restriction of the subjective cognition.

Specifically speaking, the sales party of the intellectual property transaction of national defense tries every means to sell the intellectual property of national defense at the highest price.

However, the purchase party hopes to obtain the intellectual property of national defense with the lowest price and make full use of the property.

In the process, the personal interest-centered transaction sets up barriers for the success of the transaction and adds to the transaction time, negotiation expenses and invested human resource.

Moreover, due to the distrust and suspicion, the cost on supervision also increases in the transaction process. As a result, transaction cost comes into being.

3.4 Unsmooth information exchange in the transaction of intellectual property of national defense. In the transaction process, the relevant parties have different information in varying degrees.

However, because of their orientation toward personal interest, the transaction parties do not announce their information until the opportunity most beneficial to them comes so as to maximize their interests.

In this way, the first information-occupier in the transaction process of the intellectual property of national defense tends to gain more benefit because of their possession of more information.

Ultimately, the “Small Numbers” occurs.

In the process, the unsmooth information exchange will lengthen the transaction and increase the transaction cost.

3.5 The potential contradictory emotions between the transaction parties in the transaction process of the intellectual property of national defense. When the transaction begins, the relevant parties do not trust each other. Moreover, they may in a contradictory state. Consequently, it is unlikely to create a satisfying transaction relationship, which leads to the stagnated transaction process and adds to the difficulty in the transaction.

It may also add to the transaction cost in the time and difficulty of information collection and condition negotiation, the signing and implementation of contract, supervision, etc.

4. THE INDEPENDENT VARIABLE OF THE TRANSACTION OF THE INTELLECTUAL PROPERTY OF NATIONAL DEFENSE

The transaction cost of the intellectual property of national defense is attributed to three independent variables.

Furthermore speaking, the combination of the three variables decides the transaction cost of the intellectual property of national defense.

4.1 The proprietary of the transaction of the intellectual property of national defense. The subject matter of the transaction of the intellectual property of national defense is the intellectual property of national defense.

It is one type of intellectual assets, which severs for the national defense.

To some degree, the intellectual property of national defense as the transaction asset has a weak circulation in the market.

In other words, when the national defense contract signed in the transaction terminates, the cost invested in the intellectual property cannot be withdrawn or transferred for other uses.

It is called the “proprietary” of the transaction of the intellectual property of national defense.

The proprietary of the transaction of the intellectual property of national defense is an important factor that affects the transaction cost.

Because a majority of intellectual properties of national defense cannot be re-allocated for other uses after the completion of the transaction, the loss of values will occur.

Moreover, the subject matter of the transaction cannot be replaced, thus leading to the highly mutual dependence between the relevant parties, which are accompanied by the high risks of the transaction contract of the intellectual property of national defense.

When the sale party of the transaction of the intellectual property of national defense has to invest a certain amount of intellectual assets, the opportunism is also intensified.

At this time, the purchasing party will take defense measures, such as signing formal “legal contracts” to ease the opportunism. Despite what’s the above mentioned, the sunken cost resulting from the proprietary will still brings about high transaction cost.

4.2 The risks of the transaction of the intellectual property of national defense. There are all kinds of risks in the transaction of the intellectual property of national defense.

Because of the restriction of the subject cognition of the two parties, people cannot make predictions in advance when they try to see through the future.

Coupled with the unsmooth information exchange in the transaction process between the parties, the increasing uncertainty in transaction is also accompanied by the increasing of supervision cost and bargaining cost, which results in that the transaction parties adopt the method of signing contracts to maintain their own interests.

The result is that the transaction risk intensifies and the transaction cost increases.

Under the condition of the sunken cost, the unsmooth information exchange will increase the risk of the success of the transaction.

Sunken cost indicates that the relevant party has to undertake sunken cost in the later transaction. The higher the sunken cost is, the possibilities it faces and the higher the negative influences it receives.

Besides, it also means that the unsmooth information exchange and the sunken cost exert important negative influence on the transaction.

It affects the transaction of the intellectual property of national defense.

4.3 The frequency of the transaction of the intellectual property of national defense.

The shorter the cycle of the transaction of the intellectual property of national defense is, the higher the transaction frequency is. Besides, the management cost and bargaining cost rise accordingly. However, the high transaction cost may reduce or eliminate the potential beneficial transaction. The intellectual property of national defense belongs to the intellectual asset; the transaction of the intellectual property of national defense belongs to technical transaction. The increasing transaction cost brought by the transaction frequency will directly cause the transaction parties to internalize the economic activities of the transaction so as to save the transaction cost.

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In accordance with the externality theory, generally speaking, the external economic transaction will result in the higher private cost compared to the social cost.

The internalization of the external transaction can change the external influence into the internal influence, thus eliminating the external impact, minimizing the transaction cost and optimizing the transaction state.

5. CONCLUSION

The evaluation result of the above variables can be concluded in the form of scoring. We can get the evaluation result of the transaction cost with the weighted sum. Therefore, we can get the objective data of the transaction cost of the intellectual property of national defense. The calculation formula is as follows:

$$TC=A_{TF} \times B_{TS} + A_{TU} \times B_{TU} + A_{TS} \times B_{TF}$$

TC: transaction cost

A: the evaluation score of each variable of the transaction cost

B: weight: $B_{TS} + B_{TU} + B_{TF} = 1$

TS: the proprietary of the transaction subject

TU: transaction risks

TF: transaction frequency

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RESEARCH ON THE MOTIVATION OF CONVENTIONAL WEAPONS EXPORTING - EMPIRICAL ANALYSIS BASED ON PANEL MODEL

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Abstract: Today the principal motivation for arms sales by key suppliers may be based as much, if not more, on economic considerations as those of foreign or national security policy. The exact relationship is examined by regression analysis of panel data, military expenditure and total demand during 1992-2011 for seven major exporting countries, which are USA, Western-European weapon suppliers (United Kingdom, France, Germany and Italy), Russia and PRC. The variant-coefficient and fixed-effects panel model is used to try to contain policy variables such as the development strategy of defense industry, military diplomacy as well as measurable variables such as military expenditure, in order to find out the variables' influence on arms export from empirical angle. This article reveals the evolution of major countries' arms export after the Cold War and provides some illustrations for participating in the global business of arms.

Keywords: Arms export, Export motivation, Empirical analysis.

1. INTRODUCTION

In 21st century, the global arms sales revived after the doldrums of the very beginning, and maintain rapid growth in spite of the global economic crisis since recent years. The latest CRS report ^[1] indicated that the total orders of global arms have largely increased for this decade. We have to attach great importance to the phenomenon and what are reasons for this new round of arms sales? Based on the new development trend of arms trade theory of the last decade, the motivations of arms trade have switched from political and military factors to economic factors. The new classical trade model^[2] indicated that the fundamental reason of arms trade is the different comparative advantages of each country; Anderton(1995)^[3] explained the economic motivations of arms trade through scale economy and learning economy, etc.; Levine, Sen and Smith(1994)^[4] attributed the cause of arms trade to economic interests and suppliers' reaction to recipient countries' behavioral safety;

based on the analysis of Snider(1987)^[5], Pickar(2003)^[6] indicated: international arms trade is good for saving the military expenditure. Bajusz and Louscher(1998)^[7] defined the reasons of arms trade: maintaining domestic defense industry, keeping scale economy, reducing the research and development cost of arms etc. Finding out reasons of arms trade is relatively easy; however, establishing the theoretic and empirical study framework is very hard. In this article, the authors attempt to analyze arms sales' causes of major countries after the Cold War from the economics angle; use the method of empirical studies based on panel data and depict the real intentions of major arms exporting countries.

2. DATA SOURCES AND MODEL SPECIFICATION

2.1 Data sources. We need to strictly define the "arms", which mainly refer to conventional weapon systems here, because it is comparatively easy to get statistics of conventional weapons transaction.

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According to the rank of conventional weapons' exporting countries offered by Stockholm International Peace Research Institute, we selected seven post-Cold War biggest conventional weapons' exporting countries (the USA, Russia, UK, France, Germany, Italy and PRC) as empirical study's objects. All data of arms export and military expenditure in this article are from weapon transaction database and yearbook of Stockholm International Peace Research Institute [8]. We collected those seven countries' data of arms export and military expenditure from 1992 to 2011, the export data are measured in constant US dollar of 1990, and the military expenditure data are measured in constant US dollar of 2010, both of these two time series eliminate effects of exchange-rate fluctuation and inflation, and have longitudinal comparability.

1.2 Variable selection

2.2.1 Strategic variable. Supporting and promoting the development of defense industry is a salient factor to affect the arms export of big countries, and also a variable that we tried to control in the regression analysis, however this strategic variable has non-observability, so we have to find a suitable proxy to describe. Generally speaking, equipment purchase and R&D expenditure are directly related to the realization of the defense industry development strategy. However it is difficult to obtain the internationally comparable data of time series about equipment procurement and R&D expenditures, on the contrary, the data of military expenditures are easier to get. So we selected military expenditure as the proxy variable for defense industry development strategy.

2.2.2 Economic variable. Investigating the economic factors of each country's real level of arms export can be explained separately from supply side and demand side:

1. Variable reflects supply capacity. The major factor that affects the supply of conventional weapons is not the price, but each country's technology and production scale of arms. The more advanced the technology and the stronger production capacity of arms, and the stronger supply capacity is.

Arms production processes have the features of scale economy, and assume that the price of investment is fixed, when production increased, scale economy can lead to a decrease of unit cost, so the scale economy is one of strong causes for arms export.

2. Variable reflects demand level. The actual sales volume is also affected by the total demand. Different from general merchandise trade, the core factors that affect the demand of arms are not price and exchange rate, but each country's security environment, and safety menace confronted with such as arms race, regional wars and conflicts. Moreover, the common macro-economic factors, such as global economic periodic change, and the fluctuation of international oil price can affect the total import demand of arms. In this article, we use the global total import volume (or total export volume) of arms to represent the total import demand of arms.

2.3 Specification of Model. Due to many qualitative factors, we consider establishing Fixed Effects Panel Model. In the selection of independent variables, we choose military expenditure and total demand for sure. Military expenditure represents strategic factor affecting arms export, while total demand stands for economic factor affecting arms export. It is not easy to decide which of the rest factors should be controlled. Jeffrey M. Wooldridge (2009) [9] thought, 'we should add such explanatory variables which influence the dependent variable but are not relevant to the existing independent variables.' In accordance with this criterion, we can exclude the world price of weapons, since price and demand are existing obvious linear relationship in theory. We also can give up world economic cycle, global security situation, and global oil price. These variables are directly relevant to aggregate demand of arms. According to the analysis above mentioned, we could simplify the model as follows:

$$\ln ex_{it} = c + \beta_1 \ln milit_{it} + \beta_2 \ln WD_{it} + \alpha_i + u_{it}$$
$$i = 1 \dots n, \quad t = 1 \dots T \quad (1)$$

$\ln ex_{it}$ is the log value of a country's arms export in a year; $\ln milit_{it}$ is the log value of a country's military expenditure in a year; $\ln WD_{it}$ is the log value of total demand in a year. We adopt Log-Log Model, because coefficients in log-log model represent elasticity in economic sense. Random variable α_i in this equation indicates unmeasured or unquantifiable factors concerning to individual country, such as subsidy policy for defense industry, arms control policy, the technological level for producing arms, and scale of production. c is intercept, u_{it} is stochastic error term.

3. EMPIRICAL ANALYSIS

1.1 Panel unit root and cointegration test

The panel data in this paper is large T and less N, to ensure that the equation is not spurious, it's important to test for nonstationarity. We use Eviews 7.2 to conduct panel unit root test, and table 1 shows the results:

Table 1. Panel unit root t

variables	method	type	results	P-value
$\ln ex_{it}$	LLC	(c, 0, 2)	-2.80733	0.0025*
	IPS	(c, 0, 2)	-2.67736	0.0037*
$\ln WD_{it}$	LLC	(c, 0, 0)	1.84661	0.9676
	IPS	(c, 0, 0)	0.44852	0.6731
$\ln milit_{it}$	LLC	(c, 0, 3)	0.95708	0.8307
	IPS	(c, 0, 3)	0.74072	0.7706
$D(\ln WD_{it})$	LLC	(c, 0, 0)	-3.51975	0.0002*
	IPS	(c, 0, 0)	-5.4061	0.0000*
$D(\ln milit_{it})$	LLC	(c, 0, 2)	-4.45744	0.0000*
	IPS	(c, 0, 2)	-4.28316	0.0000*

Note: * indicates 5% level of significance

We here adopt homogeneous panel unit root test method LLC and heterogeneous panel unit root test method IPS.

Table 1 indicates that dependent variable $\ln ex_{it}$ is stationary at the 1% level of significance, while $\ln WD_{it}$ and $\ln milit_{it}$ all accept null hypothesis, so the two series both have unit roots. First difference of $\ln WD_{it}$ and $\ln milit_{it}$, we get new variables $D(\ln WD_{it})$ and $D(\ln milit_{it})$; these two variables reject null hypothesis of having unit root at 1% level of significance, indicate the first differentiated variables are stationary.

The independent variable is integrated of order zero, however, two explanatory variables are integrated with order one.

What shall we do? Even though two independent variables are non stationary, it is possible for linear combinations of non stationary variables to be stationary and making the error term of the equation stationary. Therefore, we can carry out cointegration test.

Table 2. Panel cointegration test

Pedroni	Panel				Group		
	v	ρ	PP	ADF	ρ	PP	ADF
t-value	-0.1	-1.4*	-3.8*	2.0*	-0.28	-4.8*	-1.8*

Note: * indicates 5% level of significance

Table 2 indicates that Panel v-Stat and Group ρ -Stat accept null hypothesis, nevertheless the rest five statistics reject null hypothesis at 5% level of significance. All in all, we think these variables are cointegrated and have long-run equilibrium relationships.

1.2 Selection of panel models

There are three different kinds of panel models, Type one is a model with varying coefficients and intercepts; Type two is with same coefficients but disparate intercepts; and type three is a model whose coefficients and intercepts are all the same.

The first step to establish a panel model is to make sure which type it belongs to. We can first estimate restricted model, define F statistic, and carry out joint hypothesis test.

The two multiple hypotheses are as following:

$$H1: \beta_1 = \beta_2 = \dots = \beta_N$$

$$H2: \alpha_1 = \alpha_2 = \dots = \alpha_N, \beta_1 = \beta_2 = \dots = \beta_N$$

First, we estimate three kinds of model respectively, and get sum of squared residual $S_1 = 15.9$, $S_2 = 19.9$, $S_3 = 93.6$.

By computation, we get $F_1 = 2.48$, $F_2 = 32.23$. Given 5% level of significance, the critical value of F statistic is $F_{\alpha_2}(18, 119) = 1.69$, $F_{\alpha_1}(12, 119) = 1.83$. Since $F_2 > 1.69$, we reject H_2 ; $F_1 > 1.83$, we reject H_1 .

Therefore, in our paper, the model should be type one, that is, variant-coefficient model.

The result illustrates the arms export can not only be affected by cross-section unit, but also have structural difference among different countries.

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It is easy to explain that the seven biggest arms export countries have distinct economic and political regimes, experience different stages of economic development. Hence variant-coefficient model can better fit the data and explain the diversity of country's structure.

1.3 Regression results

We know in this paper, α_i represents subsidy policy for defense industry, arms control policy, the technological level for producing arms, and scale of production. These omitted variables are obviously correlated with the explanatory variables in the model; therefore, fixed effects panel model is preferred here.

Table 3: estimates of variant-coefficients and fixed-effects panel model

Variables	estimates	t-statistics	variables	estimates	t-statistics
Milt_us	-0.91	-2.42*	WD_us	2.00	3.33*
Milt_rus	0.35	1.45	WD_rus	-0.6	-1.00
Milt_uk	-1.88	-2.52*	WD_uk	0.51	0.87
Milt_germ	-0.97	-0.95	WD_germ	0.72	1.24
Milt_fran	-3.08	-1.36	WD_fran	1.03	1.76**
Milt_ita	2.27	1.89**	WD_ita	2.23	3.06*
Milt_cha	0.08	0.63	WD_cha	1.17	2.00*

Note: * indicates 5% level of significance, ** indicates 10% level of significance.

In Table 3, $R^2=0.90$, adjusted $R^2=0.88$, the estimated model fits the data well. We also find that the coefficient of military expenditure is statistically significance for USA, UK and Italy and the coefficient of total demand is statistically significance for USA, France, Italy and China. Given distinct volume of arms export of these countries, the model may have cross-section heteroskedasticity. Besides, NATO member nations usually are involved in collaborative development and production of weapons and abide by the same export control rules.

European Union member nations have similar national industrial and market structure, they intend to organize arms export cartel, and easily reach collective agreements in quality and quantity.

Hence, the volume of arms export in allies must be correlated at the same year. By observing Variance-Covariance Matrix of residuals, we do find cross-sectional heteroskedasticity and contemporaneous correlation in the residual matrix, so the estimates of model are biased and do not satisfy properties of BLUE. In order to get rid of them, we use the method of SUR, the feasible generalized least squares estimator; then we get new estimates of model as follows:

Table 4: estimates of adjusted variant-coefficients and fixed-effects panel model

variables	estimates	t-statistics	variables	estimates	t-statistics
Milt_us	-0.79	-7.02*	WD_us	1.96	8.08*
Milt_rus	0.46	2.48*	WD_rus	-0.65	-1.04
Milt_uk	-1.67	-6.31*	WD_uk	0.49	2.17*
Milt_germ	-2.1	-2.42*	WD_germ	0.72	2.29*
Milt_fran	0.4	0.27	WD_fran	0.95	1.69**
Milt_ita	1.63	1.59	WD_ita	2.00	3.12*
Milt_cha	0.19	2.50*	WD_cha	1.12	1.43

Note: * indicates 5% level of significance, ** indicates 10% level of significance.

In Table 4, after eliminating cross sectional heteroskedasticity and contemporaneous correlation, $R^2=0.982$, adjusted $R^2=0.98$, the overall-fitness of estimated model has been noticeably improved. The significance of single variable is also enhanced. Estimation results of adjusted model are better than origin model for both overall-fitness and single variable significance.

Since these three variables are cointegrated and we can first explain long-run relationship between arms export and military expenditure based on empirical results. (1) For US, UK and Germany, the relationship between arms export and military expenditure is negative, that is to say, military expenditure decreases 1% with every 0.79%, 1.67%, 2.1% increase of arms export respectively. (2) For Russia and China, the relationship between arms export and military expenditure is positive and statistically significant, that is, defense expenditure increased 1% with every 0.46%, 0.19% increase of arms export. (3) When dealing with France and Italy, the linear relationship between arms export and military expenditure is insignificant.

It shows that arms export of the two countries does not economize their military expenditure, and does not exert additional pressure on it either. (4) Focusing on the elasticity of arms export to total demand, we find that for US, UK, Germany, France and Italy, there exists significant positive relationship between arms export and total demand, that is, total demand increases 1% with every 1.96%, 0.49%, 0.72%, 0.95%, 2% increase of arms export. From the perspective of significance of estimates, U.S. and Italy are the most significant. When concerned with the value of coefficient, Italian arms export is most sensitive to the change of total demand, and the next is U.S. (5) In contrast, for Russia and China, there does not exist significant linear relationship between their arms export and world demand on weapons.

4. CONCLUSIONS

First, the market share and technological sophistication collectively determine the saving effect of arms export on military expenditure. According to empirical results, the negative relationship between arms export and military expenditure for US, UK and Germany reflects their strong defense industrial base and advanced weapon R&D and production technology. They have developed into stage of expanding arms export to promote saving on military expense. During the post-Cold War, the three developed countries gain abundant profits through arms exporting, on the one hand economize procurement expense of weapons, and on the other hand finance for high-tech weapons R&D, so alleviate the pressure of military expenditure.

Second, there maybe exist positive relationship between arms export and military expenditure. Generally speaking, high military expenditure means sufficient procurement and R&D funds which will maintain the defense industrial base. Moreover scale economy and study economy plus high input of R&D will keep weapon industry possess cost and technology advances which will further promote weapons export.

The empirical results of Russia and China conform to the rationale above mentioned. Whether Russia is at the stage is doubtful. It can be interpreted that steady policy of high military expenditure seems to neutralize the savings brought by the arms export. But China is definitely at the stage because weapons made in China cannot compete with western developed countries and Russia in either sophistication or maturity.

Third, for western developed countries, their arms exports are all sensitive to the change of total demand. It can be inferred that their market shares are quite high in the international arms market and they have developed an especially large and diverse base of arms equipment clients globally. Once global security and economic circumstances has changed, such as local wars breaking out, recovery of economy or accumulation of much oil dollars, western countries can increase their orders immediately.

Meanwhile we can speculate their elasticity of weapons production is quite high, when faced with fluctuation of demand, they can promptly adjust the volume of production; provide timely delivery and effective service to assure their clients.

This indicates that in the major western developed nations, the policy of civil-military integration and the strategy of boosting defense industry by arms export have made remarkable effects.

Fourth, Russian arms export does not have saving effect on military expenditure. The technological advancement of Russian armaments cannot be compared with its western competitors, so Russia mainly depends on competitive price to expand its arms customer base and profits gained are relatively low. Besides Russia has pursued "strong defense" strategy, and hoped to revitalize military industry as the engine of economic growth. Therefore, its constant high military expenditure neutralizes the economy caused by weapons export, and the relationship between the two variables appears positive. Otherwise the empirical results show that its arms export is not sensitive to the change of demand.

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We find that the sales orders of Russia mainly come from two big Asian clients for a decade, that is, China and India. Especially in recently years sales to the two countries take up above 80% of all its exporting volume. Even though Russia has gained lasting and stable orders from the two countries, but highly dependence on Chinese and Indian market leads to its exporting market too much narrow and concentrated, which is the main cause why Russian weapons export is not sensitive to the demand fluctuation of the world market.

Fifth, As for China, under the pressure of western advanced equipments and Russian dumping of cheap weapons, the situation China faced is much severe. In order to keep up with the competitors, China needs to increase R&D funds and usually purchases high-tech equipments from foreign countries, and this undoubtedly leads to pressure on military expenditure. On the one hand, we find that China is not sensitive to the change of demand. it shows that Chinese weapon production mainly meets the demand of its own armed forces, and rarely treats the international sales as important. It reflects that weapons made in China are not competitive enough to gain favor of the international clients.

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CONFLICT AND COOPERATION - THE INTEGRATION AND BALANCE OF GEO-POLITICS AND GEO-ECONOMICS

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Abstract: *The deepening of global economic integration challenge the traditional concept of geopolitics, and thus put a profound impact on the inter-State conflict and cooperation situations. Some scholars argue that the traditional geopolitics is based on conflict and confrontation, while the geo-economics is based on cooperation. Therefore, currently we should take the geo-economic thought as theoretical basis while abandon the traditional geopolitical thought to develop peaceful grand strategies. In this paper, the authors' puts forward that the theoretical foundation of peaceful development grand strategy should not abandon or unilaterally emphasis on geopolitical or geo-economics thought, the theoretical foundation of national peaceful development grand strategy should be the interaction and balance of geopolitics and geo-economics. This paper includes four parts. The first part is literature survey on the representative theories that emerged in recent years in this field. In the second part, the authors discusses the role of cooperation in geopolitics considering that a state is a rational beings, the national interests is the resources to maintain its life, the state's ultimate goal of cooperation is to deprive each other's sovereignty, and obtains all living resources of other states with lower cost, and thus to obtain comparative advantage and a head start for repeated games. So cooperation itself is a geopolitical competition means. in the third part, the authors discusses the role of competition in geo-economics and points out that the most basic concept of economics is not advocating that the actors achieve absolute benefit maximization through cooperation, but stresses the scarcity of resources, emphasizes the independence of market players. Economical activities can not achieve the goal of optimal allocation of resources and improving efficiency without competition. So competition is a basic concept of geo-economics that can not be ignored. In the fourth part, the authors discuss how to develop the Chinese peaceful development grand strategy which is based on the integration and balance of geopolitics and geo-economics. The author believes that, politics and cooperation, economics and competition can both be integrated. States should make comprehensive use of political and military power to ensure fair economical cooperation and safeguard national economical interests. At the same time, the state should use the economical resources to strengthen political and military power, and to fulfill Chinese peaceful development grand strategy with the interaction and balance of politics and economics.*

Keywords: *Geo-economics; Cooperation; Conflict*

1. THE ORIGIN OF THE PROBLEM

In 1990s, the Cold War ended and the world situation experienced tremendous change. The deepening of economic integration processes challenged the traditional geopolitical concepts, at the same time, geo-economics, as a branch of geo-science, is ascendant. Many Chinese scholars have done a lot of comparative study of geo-economics and geopolitics, and have formed many geo-science thoughts which were rich in Chinese characteristics.

The thoughts that have wide-range implications including the following perspectives.

Dr. Zhao Kejin, Center for American Studies, Fudan University, said that the country's values have changed, the country will gradually shift from the pursuit of power to the pursuit of peace, development and cooperation.

The change of concept lead to the change of behavior.

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The country will gradually give up force conflict in the competition process, on contrary, and they would choose the competition focus on institution, in this way, international relations tend to become co-governance in certain area and certain field.

On this basis, his new cooperation geo-science doctrine advocate that the basic logic of geopolitical science will change from the vicious circle of ‘National pursuit of power

- the geopolitical scramble key areas
- the establishment of the geographical advantage
- the challenges facing the power of other countries
- geopolitical conflict and war ’into a virtuous circle of ‘national pursuit of peace, development and cooperation
- a key competitive geographic area
- the establishment of geo-systems
- the geographical system of the crisis of legitimacy
- the geographical system reform and reconstruction’, and this virtuous circle represents the future of geo-science.

Professor Pan Zhongqi, International Relations and Public Affairs school, Fudan University and Researcher Huang Renwei, the vice president of Shanghai Academy of Social Science described their geo-economics thought systematically in the article ‘China’s geo-economic strategy’. They argue that the traditional geopolitics based on confrontation, and geo-economics based on cooperation, China should abandon the traditional geopolitical thought, strengthen the geo-economic concepts and build a national grand strategy on this foundation to achieve the peaceful development.

Prof. Ni Shixiong, the former director of Center for American Studies, Fudan University, combine the new geopolitical theory and the concept of harmonious world together, he suggested that ‘In the era of globalization, geopolitics gained a new development. In such an increasingly interdependent international community, the competitive nature of geopolitics has been injected into the composition of cooperation, especially in global issues, cooperation has become the best choice for actors on all sides to win their own interests. China’s ‘harmonious world’ diplomatic strategy is a part of the cooperation of geo-economics.

In short, some scholars hold the opinion that the start point of traditional geopolitical is conflict confrontation, while the start point of geo-economics is cooperation, therefore, the theoretical foundation of formulating national peaceful development strategy requires to abandon the traditional geopolitical aspects and take geo-economic thinking as the core.

However, after analyzing geopolitics and geo-economics theoretically, and observing the neutrality of conflict and cooperation from the history and reality, we believe that the metaphysical interpretation that ‘the start point of traditional geopolitical is conflict confrontation, while the start point of geo-economics is cooperation’ is questionable.

2. THEORY ANALYSIS OF THE GEO-POLITICS AND GEO-ECONOMICS

Geopolitics is an ancient theory of international relations, the concept of geo-economics rose with the arising of economical factors status in international relations, geo-economics emerged much later than geopolitics. While there are great differences in historical background, theoretical system and discourse symbols between geopolitics and geo-economics, their theory is essentially the same strain.

According to a summary of the Lute Walker thought, we can group the links of geopolitics and geo-economics into the following three points.

First, both theories have the function of countermeasure tool of sovereign state. Second, both theories claim to obtain the power of controlling rivals and resources.

Third, both theories agree that the competition and confrontation of national interests.

According to the comparison, we can see that the current geo-economical thoughts advocated by Chinese scholars have changed a lot from the primitive geo-economical theory.

First, the initial geo-economics emphasizes the confrontation, it is still an international political theory guiding the competition among nations, but in China it has been interpreted economical activity theory which is used to guide international cooperation.

Second, the initial geo-economics emphasizes power; focus on obtaining competition advantage by power. However, we ignore the political and military conditions of the formation of economical cooperation; we just see the cooperation as a natural existence.

Third, the initial geo-economics has point out that developing countries are not able to implement geo-economic policies, geo-economical competition exists only among developed countries, while Chinese scholars have used it to explain international relations in general sense.

Fourth, there is no fixed form of cooperation or conflict about geo-economics, it is just a game strategy, but Chinese scholars see it as unilateral static form, and believe that cooperation is the priori features of geo-economics.

3. THE ANALYSIS OF NATURAL OF COOPERATION AND CONFLICT IN THE GEO-SCIENCE

Conflicts are diverse, some are overt, and others are hidden, some are intense, and some are relatively calm. Undoubtedly, geopolitical conflicts are the most deadly. The vast majority of national interests involved in geopolitics take geographical element as carrier, this kind of interests can not be divided, it has the basic function for the survival of the nation, and it determined the identity of the nation. Under the effect of geographical elements, the geopolitics become the conflict-prone areas. This creates an illusion that geopolitics is based on conflict. In fact, geopolitics is just a strategy which is used to guide international games. The proposals that can be chosen not only include conflict, but also cooperation, there is a series of geopolitical cooperation theory in the cooperation history based on competition, it will be helpful for us to understand the cooperation in geopolitics.

In the traditional history of international relations, the conflict is more easily to be remembered by people due to tension senses, violent struggles and heroes. But the cooperation based on geopolitics in international relations is also wonderful.

When different self-help nations are threatened by one powerful rival, they will unit to protect themselves, in this way, they can increase the cost of the rival with the help of partners, thus force the rival to abandon the hostile policy, and achieve collective security. Similarly, opposing sides try to expand the scope of their alliance to exceed their opponents and share cost. And the 'balancer' who independent from every side will cooperate with the weaker side, thus decrease the cost of the competition with the stronger side, then the "balance" can make profits from their competition.

Although the form of international relations have changed, but the cooperation based on balance of power is still being used again and again. Geopolitical masters such as Mitternich and Bismarck are all masters of cooperation, the Vienna System manipulated by Mitternich and the Continent Alliance System constructed by Bismarck are both classic cases of cooperation of geopolitics; they made tremendous profits for weak Austria and the newborn Germany at a very low cost.

Cooperation is based on the common interests of both sides, and they should build the effective expectation before the start of the cooperation. States that have experienced the harsh environment of the anarchy do not believe each other, especially the weaker side doesn't believe the stronger side, though they know the benefits, they would not like to cooperate first, in case they were betrayed by the stronger side. However the stronger side may be more self-confident, while cooperating with weaker ones, the stronger country will punish the weaker countries if they were betrayed. In order to avoid being punished the weaker countries would not betray, it provides the condition of existence and development for cooperation.

It is because of the unbalanced position of both sides in cooperation that the stronger countries have to take the first move of cooperation, and provide enough public goods for the future cooperation to decrease the cooperation cost of the weaker countries. Before starting the cooperation the stronger countries must construct the effective expectation of cooperation earnings.

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The stronger countries have to bear heavier cost burden and allow “free riders”, but the stability of institutions could stabilize the future gains, the cost of a single game will decline gradually, and the total income will increase, so cooperation is still the rational choice for the developed countries.

In the process of distributing the hegemonies cooperation, the hegemonies countries have bundled their own interests and their partners' together. Cooperation demands the transfer of resources among members of the institution, the hegemonies countries export capital, technology to their partners in order to share the market of their partners; and their partners are employed in other industries such as production, transportation and service, the hegemonies countries give a small share of their common interests, in this way, they construct the interdependence between like workers and employers.

With the deepening of the penetration of interests, the initial cooperation will reach a steady state, and the division of work between countries become more clear as a result of the large-scale industry transfer and international trade, so the cooperation reaches a higher level which can be called coexistence.

From the reasoning we can see that the independence is a result of that the hegemonies countries want to strengthen their current position by institutions, and participants of cooperation reduced the development cost in practice, so they would like to make more efforts to deepen the cooperation. But this does not mean that the cooperation will produce interdependence and interdependence will produce peace inevitably. If one country find that some issues is not good for it, will resist, even refuse next cooperation. So cooperation is not the aim of countries, cooperation is just a means of making profits.

The extension of interdependence is expanding gradually, so it presents synchronized within the system; adding the differences of natural resources and policy, it lead to the unbalance among participants, some countries may develop more quickly, narrowing the gap between hegemony.

If we study all the theories comprehensively, we can see that cooperation of international relations is based on geopolitical mind, and it was produced earlier than geo-economics. Geopolitics make great contributions to international cooperation, so the theory that geopolitics is based on conflict is debatable.

Economical communicate does not have the fierce collision of diplomatic negotiate, nor does it have the death of battlefield, so it is often seen as a civilized form of allocation of resources. But it is easy to find that very few countries perished because of war, more countries died from exhaustion of resources, or the loss of national sovereignty. Economics has the ability to meet these two points; that is to say, economical conflict is a form of warfare which effects the survival of the country.

The processes of integration and modernization started from economy, during the early development of capitalism the primitive accumulation is the most important, so funds is treated as the ultimate form of wealth, in that spirit, economy did not bring the expected cooperation and peace, on the contrary, the competition around wealth brought us boycott and exclusion against each other leading to damage to trade between each other. We can say that the modern economy carries the gene of competition and conflict.

For instance, from 1929-1933, the world has experienced a depression due to excessive claims of liberalism, during this period, none government had intervned economy effectively, they insisted on the liberal creed faithfully instead. The means they used included encouraging the dumping of exporting goods, raising tariffs on importing goods and destroying a large scale of goods to keep the high price. Obviously, these purely economic means intensified international relations and resulted of the Second World War.

The cooperation and conflict in US-Japan alliance can explain the conflict in geo-economics well. This alliance was born in cold war and took the Soviet Union and China as the common enemies. With the help of political cooperation, Japan got a lot of American investment and its economy recovered from the Second World War.

In 1969, Japan had become the second largest economy in capitalist world. After the adjustment of industrial structure, Japan was no longer the primary products plant at this stage, instead, it had become a strong rival of America.

The convergence of economic structure between the two countries leads to the fierce competition of raw materials and market. In 1980s, the US-Japan trade war occurred and impacted the alliance. In the end, the United States force Japan to make concessions to avoid the future deterioration of the bilateral relations. One prominent feature of the wrestling is that: the economical competition threatened the stability of cooperation, it is the political force that protected the cooperation to continue.

In the 21st century, economical factors have not evolved into collaboration engines. What had happened in Libya in early 2011 is a very convincing example. In fact, it is the oil share in Libya urged NATO countries to attract Gaddafi after 42 years stalemate.

There were indications that the French government had signed the agreement about the oil distribution after war with Gaddafi's opposition before NATO started the war, France monopolized 35% of oil resource in Libya. And the new government in Libya declared that they will distribute the reconstruction project according to the contributions to Libyan revolution made by different countries. There is no doubt that billions of dollars Libyan gold reserves will flow to NATO countries and Chinese investment will expel Libya.

Although the conflict occurred in Libya is of limited size, it is the reflection of the capital expansion in the 21st century and the result of the competition between the great powers. It described the current situation that the great powers agents in the war in order to obtain resources and commercial benefits.

According to the observation of conflicts in geopolitics, we can see that the cooperation in geo-economics is just a special form of conflict, the endless conflict is changing the balance of power, once the balance is broken, the institution which was constructed by the former hegemony will face the danger of subversion, and the former hegemony will choose the war to protect the vested interests.

4."PURSUE PEACE BY STRENGTH, PURSUE HARMONY BY COOPERATION" DEVELOPMENT STRATEGY OF CHINA

As noted above, it isn't a fixed correlation between "Cooperation - geo-economic" and "confrontation - geopolitics". There is a complex conflict, confrontation and even war in geo-economic conditions; however, it is full of some typical cooperation examples in geopolitical theory and practice. Every country, therefore, cannot be the first to set to cooperate or confront in the interaction of international relations. Which also can never promise to bring peace to the world for international relations is a dynamic process. When opponents take the conflict means, which will get free from the interests of the country, and undermine the country's living conditions if one country lack measures to deal with conflict; if a country is in a cooperative environment, which cannot be easily take conflict and confrontation measures, or it will suffer from the opponent's retaliation and even the collective retaliation, and will bring a heavy cost burden to themselves.

Thus, whether geopolitics or geo-economic, they are be uncertain the trend of conflict and peace in international relations, and cannot be restrict countries to take cooperative or confrontational means. Geo-economic and geopolitics are the strategies of international relations practice, which are a combination means of cooperation and competition, that can really make a distinguish between them, is not by what means are taken, but their research interests or difference in types of resources.

Comprehensive the above analysis, China's future development strategy should not be defined as "peace" or "non-peaceful". Because peace is not determined by china party policy, which need cooperation of each other. China's competition in the future should follow "Recompense injury with justice and recompense kindness with kindness." Strategy, and implement "competition for peace, and cooperation for development" in the diplomatic strategy.

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In Chinese traditional philosophy, which always regarded competition as disharmonious element, so China has always adhered to avoid and aside disputes, tolerate and indulge their opponents' betrayal and hostility action, the outcome of this kind of diplomatic policy is that Chinese kindness is seen as weak by the big or small country, which also steal China's resources, implement trade discrimination, even occupy the territory of China. China's tough back on these behaviors, appear to lead to temporary cooling between the two sides, however, which creates conditions for long-term cooperation; if allow it freely develop, the final will result in each other relations' Comprehensive fully backwards, increased contradictions, even war. Thus, at the appropriate time, using the means of competition and confrontation will not only lead to war, but will help maintain global peace.

The new period of competition and cooperation means is multiple, But there is a premise that can not be shaken, that the two sides in the balance of terror." Pursue Peace by Strength", that is to achieve long-term cooperation with other countries, China must have sufficient capacity to act against the others' betrayal and revenge action, force to abandon its hostile behavior, and back to the normal track of cooperation, ensure both healthy competition.

In revenge and retaliation against the contest, eventually the two sides will embark on mutual threat of force, Who has the final revenge ability, who can win in the competition and get more benefits; China must ensure that he can survive in the final revenge, or have the ability to destroy each other with the most powerful opponents, Establish the balanced terrorist and maintain win-win cooperation.

War is the ultimate form of revenge, possessing this revenge ability requires China establish a strong national defense forces to ensure that China has the ultimate retaliatory capability when traitors appear in the bilateral cooperation or multilateral cooperation within the worldwide, which is China's fundamental premise and guarantee of international cooperation and security and which is also the obligations of China as a responsible big country in the world, China's powerful defense is the Gospel of the world.

"Pursue Harmony by Cooperation " means China will not first betray other countries in the bilateral cooperation or multilateral cooperation within the worldwide., and China will adhere to the spirit of good cooperation relations with other countries, China's choice of cooperation is not without based on Ideology sermon, but because cooperation contributes to realize China's interests, kind cooperation is the result of rational choice of China.

Kind cooperation Requires that China will not take the initiative to promote large-scale revenge, even opponents' betrayal occurs, but control the revenge in the warning range, as long as others receive warning sign and abandon betrayal and revenge action, China will not repeat revenge, and will still cooperate with them in the new starting point. Although for this China will bear the risk of suffering from betrayal and hostile attack, China's approach reduces the risk of international cooperation, and provides public goods for international cooperation and prompts the harmony of world, which is china's promise that it is a responsible big country to the world. Therefore, China's economic prosperity is not a threat to his country, but the barrier to protect the world's economic prosperity, and promote world development.

In China's own terms, " Pursue Peace by Strength, Pursue Harmony by Cooperation" this development strategy can provide a long-term stable external security environment for their economic development; sustained economic prosperity can also promote the continuous progress of national defense; defense and economic development will further promote the domestic political progress and enhance China's international political status, political, military and economic form a positive interaction of mutually pushing each other and going hand in hand.

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ECONOMIC ANALYSIS OF THE RESIDUAL POWER IN THE ARMY - FOCUS ON THE ENFORCEMENT OF THE ARMY'S BY LAW

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Abstract: *A Supervision decision in the army is actually the decision making whether or not to carry out the army rules and regulations when a disobey behavior happens. However, the army rules and regulations are incomplete because of the information costs, language uncertainty, general application finiteness, individual comprehending deviation, social influence. In the army, the supervisor is encouraged to use discretion, which means the supervisor takes advantage of tacit residual power to enhance the rules and regulations' adaptability through changing the enforcement investment and the enforcement way. Nevertheless, the flexible enforcement is a "rapier". On a positive side, a loyal supervisor's flexible enforcement is actually reasonable in consideration of the cost and the damage of rule-breaking behavior. On a negative side, a disloyal supervisor's flexible enforcement probably means an improper decision or discretion influenced by intuition, bias, political situation, etc. Whatever, same illegal behavior probably leads to different consequences, which will destroy servicemen's rational expectations seriously and do harm to norms' rigidity and rules' reliability.*

Keywords: *Army regulations, Flexible enforcement, Enforcement costs, Enforcement damages, Rule-breaking damages, Flexible enforcement damages*

1. INTRODUCTION

Flexible enforcement of the rules and regulations in the army is a common phenomenon. In face of a disobey behavior, supervisors often say: "It can either be as big or as little." Between the range from the big to the little, there exists the discretionary power. Flexible Enforcement is a two-edged sword: considering the cost and the damage of a rule-breaking behavior, a loyal supervisor's flexible enforcement is actually reasonable in spite of some risks. But we must not ignore that a disloyal supervisor's flexible enforcement probably means some improper decision or discretion influenced by intuition, bias, political situation, etc., which is harmful not only to efficiency but also to rules and regulations. And it will also destroy servicemen's rational expectations seriously and damage norms' rigidity and rules' reliability.

Organization's regulations look like the contract between the employer and the employee. One important character of the neoclassical contract theory is the perfection of contract, which means contract is signed orderly without outside interferences, the parties could predict the events might occur and consequently they have no reason to violate the contract. And even though contract's dispute happens, the third party could also enforce the contract. Ronald Harry Coase (1937) has negated the neoclassical contract's assumption of complete information and made the people recognize the transaction costs. Simon (1940) has changed the neoclassical contract's assumption of "Rational Man" with the conception of "Bounded Rationality". Transaction Cost Economics has revealed the facts that the contract is imperfect because of the transaction costs. To remedy the imperfection of contract, Grossman and Hart (1986) divided the contractual rights into specific rights and residual rights.

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Incomplete contract theory is applied into organizational management. Hart(2001) proposed a new viewpoint—assuming parties can give short-term commitment and carry through “games of commitment”, contract would become perfect after the event.

Along the idea of dynamic programming, researchers have deepened the study of contractual rights. DaiZhiyong and Yang Xiaowei (2006) has applied it into economic analysis of the law's selective enforcement.

They regarded the selective enforcement as the application of residual rights which is the remedy method for incomplete law. Anglo-Saxon's Law and Practice has the similar viewpoint: when an unexpected event happens, owner can decide how to use assets. Although many outcomes have been made as above, research in military organizational management has been scarcely involved.

To be honest, military management is a typical case because the will of commanding officer conflicts with the norms rigidity.

2. IMPERFECTION OF THE ARMY'S REGULATIONS AND RESIDUAL RIGHTS

Rules and regulations in the armed forces are incomplete for that, firstly, it's impossible for any regulations to elaborate on all conditions accurately because of information costs.

Secondly, even though there are regulations for all conditions, the language of the regulations is uncertain such as semantic fuzziness, various interpretations, language ambiguity.

Thirdly, the regulations can't be applied to the whole armed forces generally because the whole armed forces are in various different areas.

Fourthly, each supervisor has the individual comprehension deviated from others. Fifthly, there are other social influences on regulations' explaining such as policy, ideology, social status.

The first three factors on above belong to legal factors and the last two don't belong to legal factors.

All in all, the two types of factors together result in the regulations' uncertainty.

The imperfection of regulations resulted from the legal factor need to be made up by giving supervisors residual rights.

The core of residual rights is that supervisors can carry out a regulation flexibly according to unexpected circumstances. In fact, we can see some regulations' flexible enforcement in the army. For instance, scientific and technological cadres in the army should work on time in China, but working on time is not suitable for the scientific research job.

If only research outcomes should be taken into account for cadres' performance assessment, “working on time” is unreasonable.

Thus, in practice, “working on time” has not been carried out very well in many grass roots units. However, when the factor which is not legal factor gets involved such as superior supervisors tend to understand regulations rigidly and emphasize rigid enforcement, as a result, flexible enforcement rights will be drawn back - as soon as a formal file comes from the superior, the regulation of “working on time” will be carried out strictly for a short time and if disobedience happens, it will be given a heavier punishment.

3. PRELIMINARY ANALYSIS ON FLEXIBLE ENFORCEMENT: CONSIDERING COSTS

Facing disobedience, whether or not to carry out regulations and how flexible regulations should be carried out all depend on cost trade-offs. No matter how to enforce, enforcement always needs investment which can result in costs. No matter how to ignore disobedience, ignorance will always result in damages.

Because of the imperfection of regulations, any enforcement is always with flexibility. The key is to what extent flexibility should be.

It is widely believed that a decision of selective enforcement depends on enforcement costs. In armed forces, we believe it as well.

Assuming other conditions unchanged, the lower the enforcement costs are, the less enforcement flexibility will be. For instance, the cost of enforcing “working on time” is very low - the popular way of supervising is to sign in.

If only take enforcement costs into account, supervisors are easy to supervise. But reality is just the opposite that many supervisors mean to take relaxing management in scientific research unit, which means obviously that enforcement costs can't explain it.

From economic point of view, if carrying out a regulation will lead to social lost, this regulation must be an inefficient one. Just like secret protection regulation which demands inquiry for the protection of secrets before the paper is published. Secret protection regulation maybe is not an easy-enforced regulation because that, firstly, the secret check stays in the proceeding form of check.

Secondly, it has seriously reduced the enthusiasm for cadres to research in the military field in case of complicated inquiry procedures and any risks.

As a result, cadres would do more general research, which means the lost for the army.

Considering the lost, the supervisor would ignore the regulation's enforcement.

Table 1. Influence of Enforcement Costs and Enforcement Damages on Supervisors' Enforcement

		Enforcement Damages	
		Yes	No
Enforcement Costs	Low	Slacking Enforcement	Strict Enforcement
	High	No Enforcement	Slacking Enforcement

In conclusion, enforcement costs mean the resources that the regulations' enforcement will consume.

Enforcement damages mean the reductions of profit for the army because of enforcement. These two types of costs are resulted from regulations' imperfection, could be called the legal factor.

Facing disobedience, supervisors will logically choose to enforce regulations flexibly in view of two types of costs.

Beside two types of costs, there are other costs involved. If a regulation is effective, which means there is no enforcement damage and disobedience will lead to damages, which are called rule-breaking damages.

And if supervisors ignore this disobedience, the flexible enforcement will move forward to reduce norms' rigidity and rules' reliability, even imitation of disobedience, which are also called damages - flexible enforcement damages.

Table 2 Influence of Rule-Breaking Damages, Flexible Enforcement Damages on Supervisors' Enforcement

		Flexible Enforcement Damages	
		High	Low
Rule-Breaking Damages	No	Strict Enforcement	Not Sure
	Yes	Strict Enforcement	Not Sure

In conclusion, there are two types of damages and the next one-flexible enforcement damages, plays the decisive role.

If flexible enforcement damages are very low, whether or not to choose strict enforcement depends on supervisors' subjective factor.

Otherwise, supervisors will choose strict enforcement, whatever rule-breaking damages are, because they want to show their legitimacy.

4. FURTHER ANALYSIS ON FLXIBLE ENFORCEMENT: CONSIDERING SUPERVISORS' TYPE

In the army, the superior entrust the subordinate to supervise and enforce regulations in each level.

Because the agent is a self-interested man, his own target is not always in accordance with the organization target.

If compensation mechanism meets incentive compatibility, the agent would fulfill himself by fulfilling organization target automatically.

This kind of the agent is called loyal supervisor. Otherwise, he or she is called disloyal supervisor.

According to the different target, supervisors' flexible enforcement should be divided into two levels: one is the flexible enforcement by loyal supervisors, the other is the flexible enforcement by disloyal supervisors.

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4.1 Loyal supervisors' flexible enforcement. The army wants to achieve the utility at the lowest cost, so loyal supervisors' target is to look for the minimization of enforcement cost under the utility constraint.

Assuming loyal supervisors try to change the enforcement input and enforcement way to achieve the minimization of costs including enforcement costs, enforcement damages, rule-breaking damages and flexible enforcement damages.

Facing "efficient regulations" and "inefficient regulations" under different circumstances, loyal supervisors would make the different choice of enforcement.

Circumstance I: Efficient Regulations Enforcement

If regulations are efficient, there is no enforcement damage and there are rule-breaking damages once disobedience happens. Thus, loyal supervisor's target function is as below:

$$\min: C=i + n(i,w) + h(w) \quad (1)$$

In formula(1), "C" is total costs, "i" is enforcement costs, "n" is rule-breaking damages, "h" is flexible enforcement damages, "w" is enforcement way (flexibility).

Now we are trying to acquire the optimal solution for "i" and "w".

If "w" remains the same, assuming no budget constraint on "i", according to formula (1), we can obtain the optimal enforcement costs with formula (2):

$$\frac{\partial c}{\partial i} = \frac{\partial n}{\partial i} + 1 = 0 \quad (2)$$

Rule-breaking damages' increase will accelerate enforcement costs. Because we have assumed there is no enforcement damages and enforcement costs are total costs.

Loyal supervisors are looking for the minimization of total costs.

When rule-breaking damages are very serious, he has to look for another way to minimize total costs.

The way is to change enforcement way (including no enforcement input, quick input and late input), which can influence rule-breaking damages.

If "i" remains the same, according to formula (1), we can obtain the optimal enforcement way with formula (3):

$$\frac{\partial c}{\partial w} = \frac{\partial n}{\partial w} + \frac{\partial h}{\partial w} = 0 \quad (3)$$

Analysis of n(i,w): "n" is decreasing function of "i" and "w", which is

$$\frac{\partial n}{\partial i} < 0, \frac{\partial n}{\partial w} < 0$$

That means more enforcement costs and more flexible enforcement way, quicker stop of disobedience, which means much less rule-breaking damages.

When rule-breaking damages has happened at beginning, only less enforcement input can stop it. So we can say enforcement input has the biggest marginal returns.

But if damages are proceeding and after that, regulations are enforced, even more input can't stop it as time goes by and damages will become more.

So we can say enforcement input has decreasing marginal returns. In another words, we can also say enforcement input has the increasing rule-breaking marginal damages,

$$\text{that's } \frac{\partial^2 n}{\partial i^2} > 0$$

Analysis of h(w): flexible enforcement damages depend on flexible enforcement, because that flexible enforcement destroys the cadres' anticipation of steady regulation and also conflict with "governing the armed forces by law", which leads to flexible enforcement

$$\text{damages increased, that's } \frac{\partial h}{\partial w} > 0$$

And frequent flexibility can abolish the normalized usage of regulations in military, which probably leads to damages accelerated,

$$\text{that's } \frac{\partial^2 h}{\partial w^2} \geq 0$$

In conclusion, flexible enforcement not only

$$\text{reduce rule-breaking damages } \frac{\partial n}{\partial w} < 0, \text{ but also}$$

$$\text{increase flexible enforcement damages } \frac{\partial h}{\partial w} > 0$$

Thus, the influence of "w"-enforcement way- on total costs is not sure.

Strengthening the enforcement (another kind of flexibility) can make rule-breaking damages reduced a little or even cannot make damages

reduced, which means $\frac{\partial c}{\partial w} = 0$ in formula

(3) and can only make flexible enforcement damages increased, so formula (3) is impossible and the optimal value of “w” should be zero, which means the optimal solution is to enforce according to regulations.

In another condition-strengthening the enforcement can make rule-breaking damages reduced a lot, the optimal choice is more flexibility,

$$\frac{\partial c}{\partial w} < 0.$$

But more flexibility means more flexible enforcement damages. From the formula (3), a loyal supervisor will try to make the marginal returns of flexibility equal to marginal costs of flexibility.

That is to say, only if the flexibility is effective, can supervisors utilize it. So facing some trifles, supervisors should not enforce regulation flexibly.

Circumstance II: Inefficient Regulations Enforcement

If regulation is out of date, enforcement will lead to organization lost or enforcement damages, and otherwise, disobedience often will not lead to any real damages.

For this kind of regulations, the optimal choice of enforcement investment and way is zero.

In reality, this choice maybe go through a gradual process, that’s to say, the supervisor will reduce enforcement at first, and then do no enforcement.

Circumstance III: Same Regulation’s Enforcement in Different Cases

In terms of different cases, such as different groups and different districts, disobedience may result in different costs and different returns, and different outcomes of $n(i, w)$ accordingly.

This condition causes that the same regulation’s enforcement is different in different groups and different districts.

4.2 Disloyal Supervisors’ Flexible Enforcement. Armed force is a pyramidal pattern organization and supervisors in each level undergo the pressure to promote to be a higher officer.

Thus, their enforcement choice is always influenced by the political environment.

If the political environment is mild, whether or not to enforce regulations is only related to performance for promotion.

If the political environment is hard, enforcement will be strengthened to meet the superior for promotion.

The important factor influencing on promotion is performance, so this paper assumes that seeking promotion is the target of the supervisor in each level.

Circumstance I: The case with large rule-breaking damages, many peoples involved, and small flexible enforcement damages

If facing the case with large rule –breaking damages, many peoples involved and small flexible enforcement damages, the supervisor will try to conceal it by solving it inside at beginning. Thus the enforcement way is more flexible.

Circumstance II: The case with large flexible enforcement damage

Anyhow rule-breaking damages are, if the case has induced negative externality because of no control as fast as it would be, for instance, if the case is paid attention by the superior level, the enforcement will be interfered by the high level, and so the target function is same with formula(1).

Circumstance III: The case with no rule-breaking damages and small flexible enforcement damages

If the case has no rule-breaking damages and no influence of flexibility on rule-breaking damages, the supervisor will not care about it.

And if no enforcement doesn’t induce any negative externality and the superior level doesn’t care, the best enforcement choice will depend on how supervisors’ performance are related to it.

So, supervisors’ enforcement choice in this case is not sure.

5. CONCLUSIONS

Enforcement flexibility is resulted from the conflicts between the law's unification and the enforcement situations variety.

The flexible enforcement is a popular phenomenon in many countries' public organizations. On one side, regulations' universality needs to ignore the all kinds of cases.

On the other side, regulations can't easily change. If in a stable world, any regulations or laws are perfect and need not flexibility. But the world is not a stable one- situation is different and future is not sure, and there exists deviation between universal regulations and real needs, we only have two choices: the one is to abolish current regulation; the other is to enforce current regulation selectively.

Each choice has costs. If the regulation changing cost is too high, selective enforcement of current regulation would be the better choice.

So the armed forces always encourage supervisors to enforce regulation flexibly, which means the implied residual rights for supervisors, with which supervisors could enhance the regulations' adaptability by changing the enforcement investment and enforcement way.

We can see that from the above, in short term, flexible enforcement has its reasonable efficiency, which can explain the phenomenon of flexible enforcement in public organizations.

Flexible enforcement means the solution is more influenced by the supervisor's subjective factor, which is more easily influenced by the intuition, bias and political situations.

This flexibility induces that the same disobedience has the different legal ending, which will strictly upset the cadres' rational expectations and destroy rules' reliability.

As Montesquieu ever said before: it is eternal experience that the person who has authority is likely to abuse power. Supervisors' residual right could make each solution of case follow their own needs.

If supervisors don't care the disadvantages of flexibility and disloyal supervisors deliberately utilize this authority to meet their own interests, regulations will exist in name only.

This kind of flexible enforcement damages will make total costs infinitely large.

Accordingly, it is very important to put the residual rights into legal system.

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F-35 AFFORDABILITY MEASURES AND IMPLICATIONS

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Abstract: *This paper analyses the three affordability measures of F-35: facilitating affordable operational requirements with an unprecedented scope, emphasizing cost as an independent variable and a robust set of models and simulations; emphasizing acquisition reform initiatives that include cancelling MIL-STDs and MILSPECS, featuring performance-based specifications, developing the model spec; Promoting high commonality. The long term affordability challenges are also mentioned. Finally, implications are analyzed.*

Keywords: *F-35; affordability measures; affordable operational requirements; acquisition reform initiatives; high commonality*

1. INTRODUCTION

“The F-35 Lightning II, the Joint Strike Fighter, is DOD’s most costly and ambitious aircraft acquisition.

The program is developing and fielding three aircraft variants for the Air Force, Navy, Marine Corps, and eight international partners.

The F-35 is critical to long-term recapitalization plans as it is intended to replace hundreds of existing aircraft.

This will require a long-term sustained funding commitment.

Going forward, ensuring affordability—the ability to acquire aircraft in quantity and to sustain them over the life cycle—is of paramount concern” [1].

The focus of the JSF program is affordability — reducing the development cost, production cost, and cost of ownership.

“The JSF Vision is to be the model program for joint service and international cooperation and develop and produce an affordable next generation strike fighter weapon system and sustain it worldwide” [2].

Affordability is the number one consideration of the program.

This paper highlights its measures and implications.

2. F-35 AFFORDABILITY MEASURES

“... Annual acquisition funding requirements for the United States currently average \$12.6 billion per year through 2037” [1]. The F-35 JSF Program is accomplishing affordability by taking such measures as facilitating operational requirements, emphasizing the acquisition reform initiatives, and promoting high commonality.

2.1 Facilitating Affordable Operational Requirements. The F-35 program is accomplishing affordability by facilitating the Services’ development of validated, affordable operational requirements.

2.1.1 Starting with an unprecedented scope. The program’s joint operational requirements development started with an unprecedented scope. Since the beginning in 1994, “The process has involved the full-time participation of “warfighter” representatives, experienced pilots, logisticians, and maintenance officers assigned by each service to support the JSF program.

No similar requirements document has ever been produced by warfighters with such a plethora of information on which to base decisions on requirements” [3].

2.1.2 Emphasizing cost as an independent variable (CAIV). The emphasis is on cost as an independent variable (CAIV), “CAIV has enabled the programs and contractors to set and maintain cost objectives” [4].

This analysis significantly reduces conceptual and preliminary design time, which in turn reduces overall program cycle time.

This reduction in program cycle time leads to reductions in overall cost and time to market [5].

The emphasis is on balancing costs with operational performance requirements.

The goal is to do trade-offs to ensure that the requirements the Services are asking for will meet their needs, and make sure that the aircraft will come in at a cost that the Services’ budgets can afford.

2.1.3 Models and Simulations. The services have a robust set of models and simulations with which they can look at generic performance levels for a JSF, coupled with associated cost estimates provided by industry and the program office.

2.2 Emphasizing Acquisition Reform Initiatives. The F-35 JSF Program is taken as the Flagship Acquisition Reform Program.

It is the first major aviation acquisition effort that emphasizes the acquisition reform initiatives first mandated by William Perry in 1994 as Secretary of Defense [3].

The objective of these initiatives is to break the accelerating upward spiral of the cost of military aircraft programs by streamlining the DoD’s acquisition process.

2.2.1 Cancelling thousands of DoD MIL-STDs and MILSPECS. One of the major features of these initiatives is the cancellation of thousands of DoD military standards and specifications (MIL-STDs and MILSPECS).

These documents overspecified requirements, mandated “design-to” details, and limited the contractors’ flexibility in providing an optimized product.

2.2.2 Performance-based specifications. Another key feature of the reformed process is performance-based specifications (PBS) which have the following attributes [3]:

(1) specifying Functional Performance/ Results

(2) defining the Environment in Which System Must Operate

(3) defining the System Interfaces

(4) defining the Operating and Support Characteristics

(5) utilizing Measurable and Verifiable Requirements

The above attributes show that in the PBS, the government states a need for a capability by specifying functional performance, the environment in which the system must operate, the interfaces to existing or planned systems, and the expected operating and support characteristics.

For example, instead of specifying that the JSF has a radar and requiring specific design features such as power output, pulse repetition frequency, scan rate, etc., the government would specify a need to detect, track, and identify targets at tactically significant ranges.

The contractor may or may not decide to use a radar to satisfy this need; there may be some other onboard (or outboard) sensor that may perform better and be more affordable.

The point is that the contractor has the flexibility to use best design practices and leverage available technology in order to meet the need.

2.2.3 Developing the model spec. To operate in this new PBS environment, the Joint Program Office (JPO) established a PBS working group in December 1996 to develop the JSF model specification.

This group is made up of representatives from JPO, Boeing, and Lockheed-Martin who have strong systems engineering backgrounds, especially in requirements development.

The model spec. includes the following attributes:

(1) defining system performance that meets the requirements defined in the Joint Interim Requirements Document/Joint Operational Requirements Document (JIRD/ JORD);

(2) defining the minimum essential requirements necessary on contract for the government to manage the program;

- (3) specifying the request for proposal (RFP) and tailored in the contractors' EMD proposals;
- (4) being developed in a timely manner to support JSF scheduled events; and
- (5) allowing the government and contractor to minimize surprises in the "downselect" process.

All the above attributes of the model spec is intended to concentrate on the key or critical performance requirements that would make or break the program, and would include only the performance minimums contained in the JIRD/ JORD. The JIRD/ JORD will also include desired "objectives" which the contractors may decide to design in order to have a competitive advantage. What all this means is that the JSF model spec, which will form the basis of the contract spec, will contain, as a goal, 150 to 200 requirements. Contrast this number with the more than 16,000 contractual requirements on the F/A-18E/F and more than 6,000 on the F-22 [3].

As shown in Figure 1, the function of the model spec will be "contractor generic" — that is, the same for each competitor and its development is paid for by the government during the concept demonstration phase.

Each contractor will develop a "JSF contract specification" specific to its design, which will capture all of the model specifications.

2.2.4 Restructuring actions.

"In February 2010, the Department announced a major restructuring of the JSF program, including reduced procurement and a planned move to fixed-price contracts, because of additional costs and schedule delays.

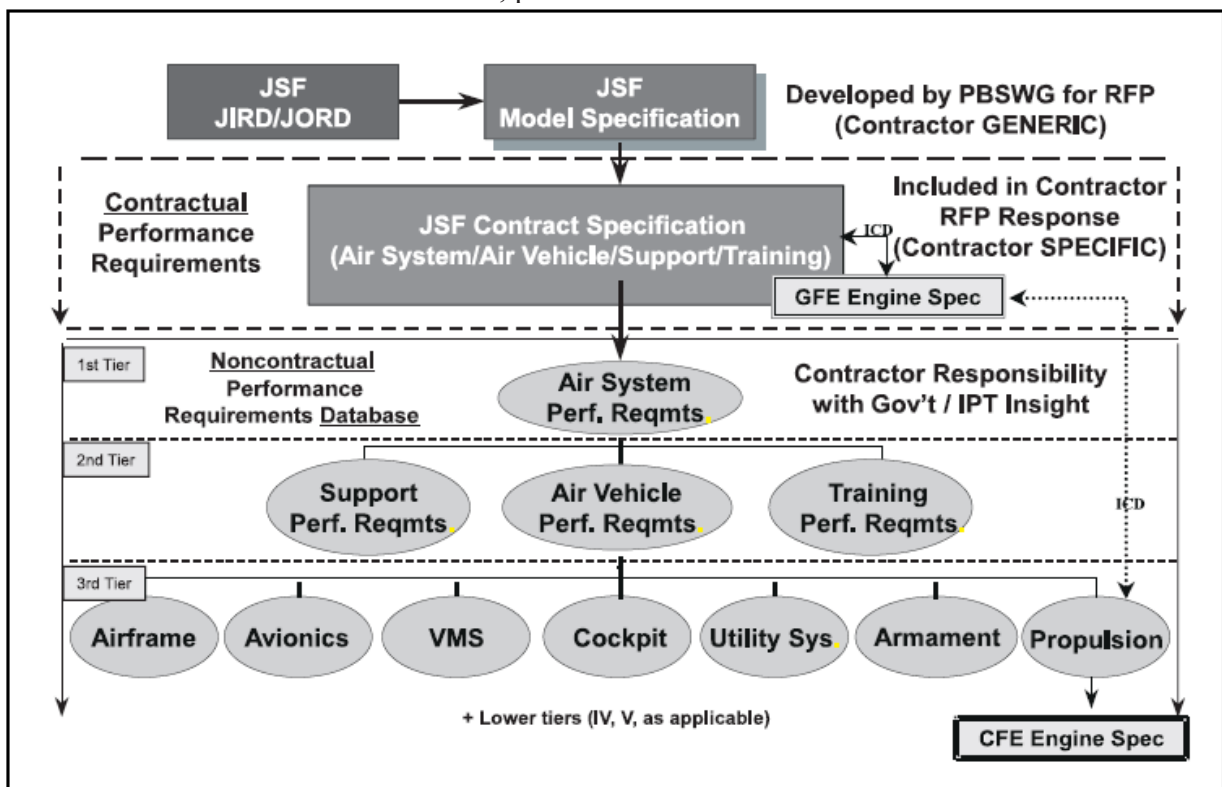
The Secretary of Defense placed the STOVL variant on a 2-year probation; decoupled STOVL from the other variants in the testing program because of lingering technical issues; and reduced STOVL production plans for fiscal years 2011 to 2013" [6].

Extensive restructuring actions have placed the JSF program on a more achievable course.

At the same time, the near-constant churn, or change, in cost, schedule, and performance expectations has hampered oversight and insight into the program, in particular the ability to firmly assess progress and prospects for future success.

"The Department's restructuring actions have helped reduce near-term risks by lowering annual procurement quantities and allowing more time and resources for flight testing.

Figure 1
A Performance-Based Specification Tree
Source: Robert G. Struth, Jr. Systems engineering, and the joint strike fighter: the flagship program for acquisition reform, Acquisition Review Quarterly—Summer 2000, p.227



Procurement funding reflects the reduction of 179 aircraft in annual procurement quantities from fiscal year 2013 to fiscal year 2017” [6].

2.3 Promoting high commonality. Another approach to affordability is that the F-35 JSF program has high commonality.

That is, the program has to meet the needs of three Services: Air Force, Navy, and Marine Corps; full partners and eight international partners and dozens of other countries buying the system and/or building major subsystems of the program with three aircraft variants based around a core of airframe, avionics, and propulsion technologies.

“The JSF family of aircraft will be designed with affordability as the cornerstone of the program with strong emphasis on a balanced “best value” approach among its operational capabilities and attributes.

The JSF will be capable of striking and destroying a broad range of targets, day or night, in adverse weather conditions.

These targets include: fixed and mobile land targets, enemy surface units at sea, and air threats ashore and at sea including anti-ship and land attack cruise missiles. The characteristics of each Service’s aircraft will be very similar; however they will be Service specific to meet their unique operating requirements” [7].

From the above process we can see that the acquisition reform initiatives will only be optimized when the prime contractors promote a relationship with their teammates and subcontractors that focus on performance-based specifications and the other aspects of acquisition reform.

3. LONG TERM AFFORDABILITY CHALLENGES

According to United States Government Accountability Office (GAO), GAO-12-437, the DOD restructuring actions only reduces near term risk, but long term affordability is challenging.

Full rate production is now planned for 2019, a delay of 6 years from the 2007 baseline.

Unit cost estimates continue to increase and have now doubled since the start of development.

“In March 2012, DOD established a new acquisition program baseline for the F-35 program that incorporated the numerous positive and more realistic restructuring actions taken since 2010.

The new JSF baseline projects a total acquisition cost of \$395.7 billion, an increase of \$117.2 billion (42 percent) from the prior 2007 baseline.” [6].

4. IMPLICATIONS

The study of the F-35 Lightning II Program throws some light on our military aircraft acquisition.

First, ensuring that the acquisition costs are affordable so that aircraft can be bought in the quantities and time required by the warfighter.

Second, accomplishing affordability by facilitating the Services’ development of validated, affordable operational requirements is of vital importance.

Finally, developing a robust set of models and simulations and emphasizing acquisition reforms can also play a key role. The government states the need for a capability by specifying functional performance, the environment, the interfaces to existing or planned systems, and the expected operating and support characteristics, concentrating on the key or critical performance requirements. Each contractor will develop a contract specification specific to its design.

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DETERMINANTS OF MILITARY EXPENDITURE IN CHINA: EVIDENCE FROM 1994 TO 2008

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Abstract: *Based on the data from the year of 1994 to 2008, an empirical model is applied to research the main determinants of military expenditures in China in this paper. There are three finds. Firstly, the main determinants focus on three elements: the demand of arms import, the development of economy, and the level of exports of goods and services. Secondly, public financial capability can promote the military spending, but it shows slight influence and cannot show statistical significance. In addition, the degree of reliance on metal imports and metal imports do not show any statistical significance on the military spending.*

Keywords: *Determinants, Military Expenditure, China*

1. INTRODUCTION

Since the original research of Lotz in 1970, researchers have paid more and more attention to the positive analysis about the determinants of military expenditures. China, as a potential great power with large population and area, attracts much interest from researchers(2006) used new classic growth model and found out that there was positive relationship among military expenditures of China, that of USA, Soviet, Taiwan and the GDP of China. Hao and Sun(2007) concluded that there was Grange relationship among military expenditures of China and that of USA, Japan and India, in addition to the GDP of China by using an empirical model. However, Jiang and Luo's research(2007) revealed that military expenditures of China was just influenced by GDP and the military expenditures of the former year. In general, most existent positive researches about China covered two kinds of variables. One kind is about the general economic development, and the other kind is about the degree of threat from outside. Because of the limitation of variables referred to, there may be some important independencies left out in analysis of Chinese military expenditure determinants.

Lotz(1970), Tait(1982), Maizels(1995) discussed the factors of military expenditures in a larger field, including GDP per capita, the level of urbanization, the size of metal exports, the balance of payments and other economic structure indicators. We get illuminance from Lotz's and others' paper related with the discussion structure factors. This paper tries to explore that whether there are economic or military structural factors influence the military expenditure in China.

2. DESIGN OF RESEARCH

2.1 Theory and Empirical Model. Factors influencing the level of military expenditures concentrate in politics, military affairs and economic fields.

Political factors Political factors include domestic and international affairs.

Researches mainly investigate the following domestic factors:

- (a) the degree of democracy, such as autarchy or democratic regime,
- (b) the degree of militarization in the government,
- (c) the degree of militarization of a nation,
- (d) the legitimacy of the governance,

Determinants of military expenditure in China: evidence from 1994 to 2008

(e) the stability of regime.

In addition, international political affairs cause variation of military expenditures, such as the broken diplomacy with some nations.

Military factors Military factors contain defense strategy, military strategy, requires of military development, military alliance, the degree of defense safety and so on.

Military alliance can induce spillover effect, which makes less requirement of military expenditures for leaguer. In the long run, the development of military technology promotes the military expenditures, because advanced weapons cost large amount of money.

Ultimately, the degree of defense safety depends on the comparison with the opponent military power. Researchers usually use the military expenditure to measure the military threat from opponents.

The higher the hostile military expenditure is, the greater the threat is, and the less the domestic safety is.

Economic factors Some economic factors constitute the demand of military expenditures. One of those factors is the gross property of the nation. Combination of the realism politics and the utile economics helps to explain the model of wealth predation (Grossman, 1995). Based on the model of predation, Liu and Hu (2007) developed a long term growth model of a country in Hobbes environment filled up with international conflicts, where national defense is the only way to prevent exterior predation.

From the model, the equilibrium economic growth path has seen three phases, which are subjected equilibrium, tolerated equilibrium and full-defense equilibrium in succession.

Different defense strategies result in different growth prospects, but sustaining growth will endogenously induce the changes of optimal defense strategy.

The conclusion of the predation model seems too theoretical. After all, there is not any country intends to be subjected to aggression because of poverty.

However, the model reveals that there is a close relationship between defense and wealth development, which is meaningful in Hobbes international environment.

From the model of Liu and Hu (2007), in such an international environment, the optimal defense spending increases with the growth of national wealth in order to satisfy the requirement of defending the growing property.

The other kind of factor demanding military expenditures is the structural characteristic of economy. For example, the degree of economy reliance on the international trade influences the need of defense from two different directions.

When the economy depends on international trade to a large extent, the country needs great defence capacity to guard the economic interest and the growing property. At the same time, the country does not need much defence power to confront with its trade partners at least, because all the trade partners may recognize the probability of both wins with non-violent solution to the conflicts between each other.

However, some economic factors constitute bounds to defense spending, which mainly lie in the public fiscal, such as the capability of fiscal, the structural of physical expenditures and so on. Musgrave and Rostow concluded the rules of public expenditures. At the beginning of economic development, infrastructures investment and productive investment use up large part of public fiscal revenue. While when economy develops to higher level, individuals pursue more social welfare. Thus, public expenditures on education, health care, social security increase rapidly. In those situations, defense spending may be crowded out.

2.2 Empirical Model. It is difficult to make a theoretical model to cover all the factors in political, military and economic fields (Hartley and Sandler, 1986). Thus, based on those theoretical explain, with the reference to research way in papers of Lotz (1970), Tait and Heller (1982), Deger and Sen (1986), Heller and Diamond (1990), Maizels and Nissanke (1987), we make an empirical model to identify the determinants of Chinese military expenditures as following:

$$MES = F(ARMS, ECO, ECOSTR_n, PE)$$

MES is the proportion of Chinese military expenditures to the world military expenditures.

ARMS is the demand of military technology development. ECO measures the level of economy development.

ECOSTRn is the characteristic of economic structure. PE is the capacity of public finance.

We think MES can cover the reaction to all opponent threat from outside.

Because assuming that each country is rational, the equilibrium situation is such a state that the relative military expenditure is stable.

Then, when the MES changes, we can find out other military or economic reasons besides the opponents' military expenditures by regression analysis.

2.3 Sample and Data. Because of reform and opening, China saw great changes in military and economic affairs.

At the beginning of reform and opening, the guideline of military strategy is preparation for a large nuclear warfare as early as possible.

Along with the transfer to focus on economic development, China started to review the international circumstance and made new guideline of military strategy in 1985, which was preparation for winning of a partial war.

According to that, forces made some great adjustments including disbarment and cut of military expenditure.

Since 1990s, defense development has been focusing on how to win a highly technological partial war.

In the field of economy, some general institutional reforms happened in 1993 and 1994, which were the adoption of market economic system and the fiscal decentralization reform respectively.

Market economic system changes the way of social welfare growth, which invokes economy growing rapidly.

Fiscal decentralization reform promotes all government developing local economy in order to gather more local fiscal revenue, which increases the central fiscal revenue at the same time.

Moreover, with the fiscal decentralized system, central government occupies more than half of the whole fiscal revenue, which is helpful for increase of the military expenditure.

Based on those analysis above, political, military and economic affairs have come into stable period since 1994.

So, in theory the determination system has been stable since 1994.

Thus, we choose the data from 1994 to 2008 as the sample for empirical analysis.

In military field, because the share of military expenditure internalizes the influence resulted from the changes in military expenditure of other countries, the rest military demand for defense spending lies in the development military technology.

There is substantial lagged gap between China and the developed countries in military technology, which means that China has rather limited capability in research and production of advanced weapons, and China has to depend on import to improve armaments to some extent. In fact, China has seen a great amount of armaments import for several years. Thus, we may use the index of armaments import to measure the influence of technology development.

As to economic factors, firstly, we think GDP per capita is better to measure the economic development than GDP. Secondly, with reference to the economic structure, we mainly describe and measure it from four views as the following: the reliance on goods and service exports, the reliance on fuel imports, the reliance on fuel exports, the dependence on metal imports.

Table 1. Factors Description

Factor	Index and Calculation
Demand of military technology development	Quotiety of arms import (Armsims) =Import of arms/ world import of arms
Development of economy	Quotiety of GDP per capital(Pergdps) =GDP per capital/ GDP per capital of the world
The structure of economy	Quotiety of goods and service export(Exps) =Export of goods and service /world export of goods and service
	Quotiety of fuel export(Fuelexps) = Export of fuel/ world export of fuel
	Quotiety of fuel import(Fuelims) =Import of fuel/ world import of fuel
	Quotiety of metal import (Metalims) =Import of metal/ world import of metal
Public Fiscal capacity	Capacity of public fiscal expenditure(Pes) =Public expenditure/ GDP

Data come from database of China statistic bureau, SIPRI and World Bank.

In fact, no matter the degree of safety or the scale of wealth, relative index makes more sense than absolute index.

Thus, we choose the relative indexes to measure those factors above. Table 1 shows the calculation of those relative indexes respectively.

The public fiscal capacity is calculated based on data from China statistic bureau. The ratio of Chinese military expenditure to world military expenditure is calculated according to data from SIPRI database. Other indexes are calculated with data from World Bank database.

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3. RESULT

Using OLS, we get the regression results showing in Table 2. Comparing the results of all those models, model 2 fits the data to the greatest extent. Model 2 has the smallest AIC, SC, and the greatest F, which all shows that model 2 is the best regression among those models. According to White Heteroskedasticity test, there is no heteroskedasticity in model 2. DW of model 2 equals to 1.91467, lying in (du, 4-du), which means there is no auto correlation neither. We carried though root test on series of Mes, Armsims, Pergdps and Exports. We find they are all I(2). Then we made ADF test on residuals of Model 2.

Table 2. Regression results

Model	1	2	3	4
C	-0.0013	0.0002	-0.0008	0.0004
Armsims	0.0222 **	0.0195 **	0.0170 ***	0.0186 ***
Pergdps	0.1025	0.1062	0.0952	0.1243
Exports	0.3161 *	0.3113 *	0.3402 *	0.3412 *
Fuelims			0.0031	0.0033
Metalims				-0.0039
Pes	0.0001			
AIC	-9.8811	-9.9565	-9.8526	-9.9177
SC	-9.645	-9.7677	-9.6166	-9.6344
A.R ²	0.9891	0.9895	0.9888	0.9898
F	317.6048	439.4309	308.6246	271.3675

*, **, *** mean significant at 1%, 5% and 10% respectively.

As Table 3 shows, ADF test results show that residuals of Model 2 is stationary, so we can conclude that there are cointegrations among Mes, Armsims, Pergdps and Exports. In sum, we can accept model 2 technically.

Table 3. Tests on Model 2

White Heteroscedasticity Test				ADF Test	
F-statistic	0.431117	Probability	0.839426	ADF Test Statistic	Critical Value
Obs*R-squared	3.665026	Probability	0.721900	-3.464614	1% -4.0113
					5% -3.1003
					10% -2.6927

4. CONCLUSIONS

We find that China's military expenditure grew with the increase of the requirement of military technology advancement, the development of economy and exports of goods and service from 1994 to 2008, which means that China has reacted to some of the development of economy to some extent since 1994.

However, the empirical analysis shows no significant relationship between military expenditure and China's reliance on fuel and metal import. It may be not suitable for China.

Nowadays, it is resources that many diplomatic affairs and national security policies focus on for most countries.

China is one of the greatest producers and also the greatest demander for resources in the world, especially for the oil, natural gas and metal.

Although China is trying hard to transfer to a new innovation economy pattern, which makes China rely on resources less, it need a long time to realize it.

Moreover, there is not much possibility to find out new substitutes for fuel until now considering nowadays science development.

So it is vital to gain the conventional fuel, metal and other important resources for Chinese economic security and development.

For the security and sustainability of economy development, China should strengthen the navy and air forces, which might lead to increasing the amount of military expenditure.

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COMPARATIVE ANALYSIS ON DATA SOURCES OF ARMS TRADE

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Abstract: *There are two reliable sources for acquiring arms trade data, one is from us government intelligence agencies which regularly release the up-to-date data through official research reports; another is from Stockholm International Peace Research Institute, which periodically updates its online arms trade database or publishes SIPRI yearbook each year. We deliberate on the two main resources for arms trade data and find there exist many differences which respectively are, main information sources, definition coverage, pricing method, and contents published. Through contrastive analysis toward different sources, we summarize their merits and demerits respectively and conclude that answering different questions about the arms transfer needs to choose pertinent types of data.*

Keywords: *Arms trade; Data sources; Comparative analysis*

1. INTRODUCTION

Arms trade is one of the most intensely discussed issues in the public at large, as well as in the social sciences. Scholars have looked at various aspects of arms transfers and drawn conclusions from existing data, but seldom have the questions of validity and accuracy of the data.

It is common knowledge that data on arms transfers are especially unreliable and open to manipulation.

Still, one finds scores of empirical studies and policy papers based on the existing data.

In this paper, we first make a list of all sources for data of arms trade, and find out the most reliable and authoritative ones.

Next, we compare data from different sources and sum up their respective merits and demerits. Based on the analysis, we draw this paper's conclusion.

There are basically four institutions that put out arms trade data of some kind, which is as following: One comes from researching reports provided by US official institutions.

The most common cited reports fall into two categories.

One kind of report is prepared annually to provide Congress by Congressional Research Service, (CRS) whose name is 'Conventional Arms Transfers to Developing Countries'(CATDN);

Another kind of report is annually published previously but now irregularly issued by the Bureau of Verification and Compliance,(BVC), whose name is 'Word Military Expenditures and Arms Transfers'(WMEAT).

Stockholm International Peace Research Institute which is a semi-official research institution also a reliable source for arms trade data, SIPRI periodically updates its online arms trade database or publishes SIPRI yearbook each year.

The database and Yearbooks provide materials about conventional weapons transfers to countries, international organization, and non-state military groups since 1950.

International Institute for Strategic Studies (IISS) in London annually publishes a yearbook named 'the Military Balances' that contains data of conventional weapons transfer too, while the data is not collected by IISS itself but cited from CRS reports.

Besides, over 140 countries report to United Nations the import and export of 'weapons and armaments' of their own countries and we can query data through UN Commodity Trade Statistics Database (Comtrade data).

But it is of the limited use; first, not all countries submit to the United Nations, some major weapons exporting countries do not submit their data.

Second, the statistic of arms deals is not complete, for example, warship, combat aircraft, and electronic equipment for military use do not include in it.

Compared with IISS and Comtrade data, WMEAT, CATDN and SIPRI are more authoritative and reliable sources for researchers.

2. COMPARISON OF TWO DIFFERENT DATA SETS

It is found that the arms trade data provided by different institutions makes a big difference which is embodied in the following aspects:

2.1 The difference of definition. The definition of arms transfer in WMEAT is that: "[1]Arms Transfer represents the international transfer of military equipment and related service, including weapons of war, parts thereof, ammunition, support equipment, and other commodities designed for military use, as well as related services.

Among the items included are tactical guided missiles and rockets, military aircraft, naval vessels, armored and non-armored military vehicles, communications and electronic equipment, artillery, infantry weapons, small arms, ammunition, other ordnance, parachutes, and uniforms.

Dual use equipment, which can have application in both military and civilian sectors, is included when its primary mission is identified as military.

The building of defense production facilities and licensing fees paid as royalties for the production of military equipment, as well as equipment delivery, maintenance, operating and training services, are included when they are contained in military transfer agreements.

Military services such as training, supply, operations, equipment maintenance or repair, technical assistance, and construction are included where data are available. Excluded are foodstuffs, medical equipment, petroleum products and other supplies."

CATDN is prepared annually to provide Congress with official, unclassified, quantitative data on conventional arms transfers to developing nations by the United States and foreign countries for the preceding eight calendar years for use in its policy oversight functions.

The values of arms transfer agreements or deliveries in the report refer to [2]"the total values of conventional arms orders or deliveries as the case may be, which include all categories of weapons and ammunition, military spare parts, military construction, military assistance and training programs, and all associated services."

SIPRI is the source which only provides the data of conventional weapons transfer.

The arms trade database mainly records transfers of weapons which fall into the nine categories.

That is, aircraft, armored vehicles, artillery, sensors, air defense systems, missiles, ships, engines and other [3].

The statistics presented refer to these nine categories only. Transfers of other military equipment, such as small arms and light weapons, trucks, artillery under 100 mm caliber, ammunition, support equipment and components, as well as services or technology transfers are not included.

2.2 The difference of statistical caliber. Based on the definitions above mentioned, we find that the caliber of SIPRI is the most narrow, which only record the transfers of conventional arms. Whereas US official statistical caliber is much larger, it not only includes conventional weapons but also contain the small and light arms, dual-use commodity, technical support and services.

It should be pointed out that the statistical figures in WMEAT and CATDN exist in differences though they are all the U.S. official publications.

The U.S. Arms exports in WMEAT accounts include private enterprise to enterprise or enterprise-to-government exports under the Direct Commercial Sales program administered by the Directorate of Defense Trade Controls (DDTC) in the Bureau of Political-Military Affairs of the U.S. Department of State, as well as government-to-government transfers under programs administered by the Department of Defense.

We find that CATDN only contains the data from DOD, that is, government-to-government arms deals. So, for US arms trade, the data of WMEAT is larger than CATDN.

2.3 The difference of collection channels.

The data of SIPRI's arms transfer project are from variable sources: ^[4] newspapers, periodicals, books, monographs and annual references, nationally and internationally official documents, industrial information, blogs and other publications from internet.

The common adoption criterion of all those sources is publicly published and available. SPIRI is prudent with single-source data, and only the data from at least five different sources can be regarded as reliable.

WMEAT and CATDN are different from SIPRI in collecting data; they do not rely on the independent data of arms trade, but excerpt from official sources of American governmental organizations. Specifically, Defense Intelligence agency (DIA) and other intelligence services of USA are in charge of collecting the arms trade data of the USA and other countries.

For the confidentiality, the intelligence collected by DIA is not announced externally, and those published reports only quoted some total volumes of the data that are consistent with the data of CIA and DIA.

2.4 The difference of pricing method. The arms trade data of SIPRI is not the trade volume of arms transfers, or the currency amount of the actual payment, but a quantity index, which is called Trend-indicator values (TIV)^[5].

SIPRI used the TIV to indicate every weapon or subsystem in the database, and then figure out quantities of roll-in, roll-out and mutual transfers among different entities on the basis of the TIV and the amounts of delivered arms systems or subsystems of the designated years. Consequently, TIV doesn't indicate the actual amount of arms transfers, but an indicated value of transfer volume.

Therefore, it's pointed out in the annual report of SIPRI that "TIV should not be applied directly, and it's better regard it as a sort of original data, and use it to measure and calculate the trend of international arms transfers, the percentage of supplier countries and recipient countries, or the ratio of designated countries' external transfer volume and received volumes from other countries. American government's official data is the actual agreement value of arms transfers' contracts or arms transfers' actual delivered values of the year, to facilitate totaling or longitudinal comparison, American government often provide current US dollar and constant US dollar as two different measurement units.

If SIPRI provides one kind of TIV but not the actual value of arms trade, does that mean the agreement value or the delivered value of WMEAT and CATDN are true and accurate?

In fact there is indication that WMEAT and CATDN often use price index to calculate the turnover, especially when other countries' arms trade amount of export and import involved.

The price index here is mainly calculated by estimating military hardware's production cost or military use-value.

2.5 The difference of contents. The data published by CATDN are the contract agreement value or actual delivered value of conventional weapons, which have been transferred from USA and other major arms supplier countries to developing countries during the last 8 years, the statistics cycle was calendar year, and there were updates of data every year.

At the meanwhile, CATDN provided developed countries' data of roll-out arms total volume around the world, but the research focus was arms transfers to developing countries.

The report also announced a large amount of proportional data, such as static and dynamic market shares of each major supplier country, and the ratio of amounts of money of military hardware transferred to developed countries and developing countries. Moreover, CATDN provided the quantity of major arms systems transferred from major arms supplier countries to developing countries during the last 8 years, and divided by regions to count the quantities of all kinds of conventional weapons rolling in each continent and each region.

WMEAT recorded the arms transfers' agreement value and delivered value of every country in the world from 1963 to 2005, the statistics cycle was fiscal year, and there were three different kinds of data: the first one was divided by geographical areas and about every-year quantities of arms flow of designated areas; the second one was grouping countries by revenue and about every-year quantities of arms flow of countries with designated revenue; the third one indicated every single country's arms import and export volumes.

At the same time, WMEAT provided the data of total volume of global merchandise trade, and calculated the proportion of arms trade volume in the total volume of merchandise trade. With those data, we can compare the competitiveness of each country's arms export expediently.

SIPRI provided the actual delivered data of military hardware's import and export of one country in one year, the time span was from 1950 to 2012.

All those data were counted per country and per calendar year, and updated every year.

The latest update was finished March 18, 2013. Besides, SIPRI provided detailed army transaction lists.

The contents of lists included the category of conventional weapons imported or exported by one country during certain period, the amount of imports and exports, the name and model of the arms, brief descriptions of conventional weapons, the years of signing agreements, the delivery years of army, and some information about transaction cost and transaction mode.

3. THE ADVANTAGES AND DISADVANTAGES OF DIFFERENT SOURCED DATA

From Table 1 of analysis of differences for different sourced data, we can see that they have their own advantages and disadvantages.

The advantage of WMEAT is that it provided arms transfers' agreement value and actual delivered value, and the data not only include quantity information but price information of military hardware.

Moreover, WMEAT's definition for arms has the most extensive coverage, and the data in the reports have most categories and most types that can fulfill many kinds of research needs.

The disadvantage is that the reports updated only to 2009 and stopped publishing, so there is a lack of latest data that WMEAT can't meet the needs of army trade trend analysis and empirical study for recent period.

CATDN emphasizes on providing the data of major arms supplier countries' conventional army transfers, specifically, those countries are the USA, the UK, France, Germany, Italy, Russia and PRC.

WMEAT and SIPRI don't have a focus, and counted the data of all the countries' arms imports and exports all over the world.

Besides, the biggest disadvantage of CATDN is that its reports update every 8 years, i.e. it doesn't update all the historical data, at the moment we can only get the latest data from 2004 to 2011, but not other years' latest data.

Table 1. Comparison of army transfers' data

	Time span	Categories of weapons	Transaction type	Statistics cycle	Measurement unit	Category of data
WMEAT	1963-2009	Major arms systems; accessory equipment; technical support and training services; dual-use commodities; Small and light weapons	Intergovernmental trade; trade between government and enterprise; trade between enterprise and enterprise	Fiscal year	Current US dollar; Constant US dollar	Single country; grouped countries and areas
CATDN	1974-2011	Major arms systems; accessory equipment; technical support and training services	Intergovernmental trade	Calendar year	Current US dollar; Constant US dollar	Single country; grouped countries and areas
SIPRI	1950-2012	Major arms systems	Transaction among countries, international organizations and nongovernmental armed organizations	Calendar year	TIV; constant US dollar of 1990	Single country

And every time when CATDN updated its reports, there was a big difference between the old data and new data that lowers former-years reports' value of reference.

The advantage of SIPRI is that it is the only one who provided the data of worldwide all major conventional weapons transfers since 1950, and has the longest time span, what's more, all the data counted with the constant US dollar of 1990 that get rid of the influences of inflation and exchange rate fluctuation, and make the time series data have consistency and comparability.

The disadvantage of SIPRI is that its reports only counted the data of conventional weapons, but not including other weapon categories and related services and technical supports.

The data of WMEAT are comparatively more authentic than the one of SIPRI in indicating the amount of arms flow, because it covers all types of arms transfers.

Besides, the TIV of SIPRI indicated the amount of conventional weapons transfers, but not including price information, the information volume of the data is relatively small.

Thirdly, SIPRI doesn't provide grouped data, like grouping countries by region or revenue. However, CATDN and WMEAT reported not only single country's data but grouped data by regions.

To be objective, there are some obvious disadvantages of above-mentioned different sourced data in accuracy, clarity and availability, and for strictly scientific significance, those data should be used conservatively or be used with special notes and explanations.

We think that to use the data accurately, on the one hand, it is necessary to choose the data according to the objectives of the research; on the other hand, we should solve the existing problems of the data to better fulfill the requirements of research.

But in the short term, creating a new data collection organization, or expanding SIPRI's capability, or making intelligence agencies of the USA announce the confidential data are impossible.

Therefore we have to be prudent with different sourced data and use them reasonably, in order to ensure furthest the objectivity and accuracy of our research conclusions.

Comparative analysis on data sources of army trade

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THEORETICAL BASIS AND POLICY ADVICE ON INVERTED FISCAL MOBILIZATION

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Abstract: *Inverted fiscal mobilization (IFM) is a resources allocation mechanism in emergency, which reallocate military resources by military finance to provide non-traditional safety. In order to improve the army's ability about managing with multi-threats, and to promote the harmonious development of economic construction and defense construction, we must bring the IFM into effect efficiently. When the malignant trend and incidence of non-traditional threats exceed a certain degree, and when the marginal transaction cost is not less than the difference of marginal administration cost by the military organization and the enterprise organization, IFM should be put into practice. The optimal scale of IFM is the military spending allocation equilibrium between the traditional safety protecting and the non-traditional safety protecting on the premise that the minimum demands of traditional safe and non-traditional safe are satisfied. In order to upgrade the IFM's ability, the optimal institution should be constructed through optimizing manage system and manage mechanism.*

Keywords: *Military expenditure allocation, Non-traditional threats, Theoretical basis, Policy advice*

1. INTRODUCTION

Military expenditure ensuring on the non-traditional safe in emergency like expense support about participating in 5·12 earthquake rescuing and relief and fiscal mobilization during wartime are both resource allocation mechanism in emergency. But the latter is financial resources gathered from civilian domain to military domain, and the former is form military domain to civilian domain. So the former is called by us Inverted Fiscal Mobilization(IFM).How to carry IFM into execution efficiently is not clear in the policy and institution, which resulted in all kinds of problems about the resources allocation disequilibrium, inefficient functioning, and so on. This is the bug about the defense economics mainstream theory, which is constructed in the view of the traditional security theory. The view of the traditional security theory is about that military security and political security are the main content of the national safe, and studying how to solve the traditional security is challenged by realism.

Even if we can acquire the traditional security, but it doesn't mean that at the same time we have acquired the non-traditional security. So the defense economics mainstream theory cannot give the answer to the IFM's problem. The study in this topic would answer this question, which perhaps not only help working out the IFM's policies and institution and provide national security, but also help enrich the theory about economy mobilization and impel the development of defense finance and economy theory.

2. THE ESSENCE AND MEANING OF IFM

Fiscal mobilization(FM) is an activity that country allocate and reallocate social production in a financial way which satisfies the need of war and concentrate finance to guaranteed the expense of war (said by Wang Chaocai and Liu Shangxi, 2007) IFM but is an activity that military reallocate the fixed guarantee non war military operations.

From the two definitions, it is easy to find that there is no obvious distinguish between FM and IFM indeed, and both of them are a kind resource allocation in emergence.

But the purpose of the former is raising war funds while the latter is supplying expenditure for non military operations.

From the object of Mobilization or the coming of Mobilization resources, though they both are fiscal resources, the former is mainly from individual citizens or organizations and some other non military domain, while the latter is mainly from military domain, and is to reallocate the specific military expenditure.

In fact, what the meaning of “Inverted” is reflected here. What can be seen from the purpose and coming of mobilization is that FM is “shifting resources from marketplace to the battle ground.” Which means the process of shifting the civil financial resources to military financial.

While IFM shifts resources from the traditional country security resources supplying domain to social security domain and is the process of shifting military expenditure to the civil finance.

What’s more, we can see from the mobilization that the former’s is the central government, whose implement is in coordination with army, the latter is mainly army.

From the method FM, mainly include budget administration tax policy, sale of bonds, income distribution etc (Pigu, 1921; Keynes 1941) IFM is main method is budget administration, implementing forcedly by military command mechanism.

From the mobilization environment and effect to see, both are in an market economy back ground but the former is a kind of decollating to fiscal resources and need to care about the influence on the operation, while the latter is a kind of decollating to military resources and need to care about the effect on the traditional security function.

3. THE THEORETICAL FOUNDATION OF IFM

With the concept of security, one country mainly face with the traditional threats, which come from the outward of economy society, like typical the other nations aggression, and the national defense security is mainly military security at this time.

According to this point view, there is a mutual benign mechanism between economy society development and national defense security.

On the one hand, the condition of the economy society development not only determine the quantity and quality of military member and the army’s weapon level, but also the mechanism and information of army, battling pattern, as well as the form of military stratagem.

So economy construct can support the solid material foundation to national defense construct.

One the other hand national defense security can give an stabilize external environment to the development of economy society, so if the enemy invade us and we lack of national security, our national survival would lose support, not to mention economy construct and social development.

In terns of developments, economy society development and national defense construct is mutual promoted.

Because the development of economy society can strengthen national economy, so as to support more economy resources to national defense construction and our national security can get guaranteed.

While the rising economy extent of national security conversely promotes the development of society, so the rising extent of national security increases the opportunities of economy rising, except for supplying a good economy rising environment.

Participating in some economy activities might undertake a bit risks when the safety level of one country relatively is low.

This kind of behavior could be retrained to some extent, while people predict little risks when the level rises, and their desire to undertake the risks will be much stronger.

The American economist, Louis believe that, tradition and taboo can restrict opportunities, while breaking away from them and undertaking risks will acquire more economy boom opportunities.

The greatest boom occurs in the society one can find the opportunities and prefer to inspiring with enthusiasm catch the opportunities.

In fact, setting up a keynote project that can rise our economy has been in debate in our country in a long time, and the points of contradiction always concentrate on whether national security can support its regular operation.

There is an obvious example as setting up the Three Gorges irrigation project.

With the further development of economy society, national security level can rise; as a result, they both increase circularly. Seen from the opposite direction, if the development of economy society retard or stagnate even fall back, national defense construct must lost support even be encumbered.

The decline of national security necessarily lower the confidence to develop economy society and reduce the investment opportunities the disadvantage aspects of the development of economy society will be worse, and resulting in low national security, at least vicious circle is formed.

As non-traditional security threatening becomes increasingly predominant, the meaning and extension of country security concept enlarge continually.

The traditional security conception which contains military security mainly is gradually replaced by the new country security concept which is made up of all kinds of securities.

As is believed in the new security concept, non-traditional security threats have the independent generating mechanism and popular harm.

It means that in the post cold war time no matter how different each country's national conditions are from social development and security requirement, country security will be confronted with the double challenge of traditional threatening and non-traditional threatening.

In fact, our country is not only affected by the traditional factors of territory dispute and regional armament race, but also threatened by the non-traditional threatening factors of terrorism, national separatism, region extremism and ecological environment, which means even if the outer threatening is removed, the development of economic society may not have access to enough security insurance, because of the non-traditional security threatening source coming from the inner society.

Obviously, the existence of non-traditional security threatening directly course the partial invalidation of the self-fit mechanism in which the economic society development is in harmony with the national defense development in traditional security concept.

Due to the fact that non-traditional security threatening coming from these years is increasingly serious nowadays, some threatening can only be eliminated when military force gets involved.

Consequently, the key to realizing the harmonious development of economic development and county defense development lies in whether the army is duties can be expanded from traditional security protect to multi-directions.

As a result, from this point, enforcing opposite direction finance mobilization and extending the use of military forces from protecting national security to traditional security areas are the inevitable choice to maintain the positive interaction between economic society development and country defense establishment.

4. THE TIME AND SPACE DIMENSIONALITIES OF IFM

If we regard non-traditional safety as a kind of production, because of its non exclusion and non competition, it belongs to a public production. We must obey the principle that first cost suits income, that is to say that we ensure the range who should be responsible for the first cost according to the range who get benefit. Benefit range is to say that benefit from traditional safety is limited by region, the residents in this region benefit while the others don't.

The main body to be responsible for the first cost is who bear the cost of traditional safety production, and government always becomes the direct main body as a muster of public requirements. Usually, the local government should undertake the cost when the influence range is limited in a fixed region and can take concrete strength, like safety personnel, policemen, to supply non-traditional safety. When we face the big threat that related with several regions even the whole country, our center government should afford the corresponding cost without the consideration of cost sharing mechanism and the non-traditional safety should be supplied by army. In this perspective, when non-traditional threat do harm to several region even the whole country benefit, we should consider IFM implement.

Hypothesis does not consider time constraints when the market price of the traditional new classical model, the producers will organize production according to consumer preferences, and according to the market to adjust production at marginal cost equals marginal revenue, so as to realize the profit maximization through such market forces can in the case of cost minimization of organized rescue and relief as well as the victims of the life safeguard.

From this perspective, using market mechanisms to produce public goods (the provider of public goods is still by the government), the use of social forces to carry out the victims supply security is the most efficient. After joining the time constraints, however, the conclusion is no longer true.

Because of the influence of transaction cost facts will continue to highlight. At this point, the normal operation of the market conditions is damaged, the price mechanism fails, producers to deal not only in search needs, looking for transaction objects trade negotiations, trade agreement, trade pay more than the market sound on transaction costs, market mechanism and the destruction of the negative effect on the trading behavior produces a lot of additional cost.

And with time constraints enhancement, the transaction cost increase. Therefore, in this case, providing salvation through market mechanism is not always best-efficiency.

Also, on the other hand, if you don't consider time constraints, under the condition of the division of labor and mature market, production efficiency of the below the market efficiency.

In other word, the army production efficiency of the people's production and living facilities necessary after a disaster is far lower than the latter. If joining the time factor, however, backing in the real world, also need to modify.

As mentioned above analysis, the market of the enterprise in order to conclude the transaction, at this time, will pay a high transaction cost, and high and even unable to reach a deal.

And army bureaucratic organization structure, make the allocation of resources within the armed forces and the production process in accordance with the administrative commands and plan to arrange, thereby greatly reducing the transaction cost of a rescue operation, therefore, in the case of time constraints, the stronger, the transaction cost factors are the key to decide the production efficiency, should choose military force to maintain the non-traditional security at this time, but after time constraints gradually relaxed, the transaction cost factors weakened gradually, the management cost and cost of production factors gradually highlighted, at this time shall be selected to socialization, use market mechanisms to implement security.

If we use C_1 and C_2 to represent the all cost doing rescue and relief work of enterprises and military organization, use t to represent time. then:

$$\begin{aligned} C_1(t) &= C_{ET}(t) + C_{EMP}(t), \\ C_2(t) &= C_{AT}(t) + C_{AMP}(t), \end{aligned}$$

The C_{ET} and C_{AT} the equation represent the transaction first cost of enterprises and military organizations, C_{EMP} and C_{AMP} represent the first production and administration cost of their operations.

Generally speaking, army takes the military command mechanism, so C_{AT} almost equal with 0.

Calculate the differentiation of $[C_1(t), C_2(t)]$ about time, if $MC_{AMP} - MC_{EMP} < MC_{ET}$, IFM should be carried into efficiency;

while if $MC_{ET} < MC_{AMP} - MC_{EMP}$, we can use market adopting the social supply method.

So, the t is boundary to end IFM when $MC_{AMP} - MC_{EMP} = MC_{ET}$, the add should be given by other government department after this, like department of civil affairs, the social security department etc.

5. THE OPTIMAL SCALE OF IFM

Dealing with various threats and performing diversification military activity are mission requirement which new stage gives to army.

But under the budget constraint, the more resources allocated at traditional safety, the less allocated at the non-traditional safety.

So IFM have the optimal scale. Here we assume there is a reasonable military leader who pursues for best country safety function, because in the new stage, military function includes maintaining traditional safety and non-traditional safety, so the size of the national security function mainly refers to the function of traditional safety (S1) and non-traditional safety (S2); meanwhile the military recourses that achieve this general security function are form state funding, in other words, it subjects to budget constraints.

In this way, military leader must make the military spending allocation equilibrium between the traditional safety protecting and the non-traditional safety protecting on the premise that the minimum demands of non-traditional safety and non-traditional safe are satisfied.

Our thought is finding this equilibrium conditions to decide optimal allocation of total military spending between two functions, and then ensure the optimal scale of IFM. Next we will use modeling to solve optimal scale.

Build Stone-Geary form model, and then:

$$W = \alpha \log S_1 + (1 - \alpha) \log S_2$$

$$= \alpha \log(MTS - M^*) + (1 - \alpha) \log(MNTS - T^*) \quad (1)$$

Among them W represents security function, α is security preference parameters, and α and $1-\alpha$ represent the financial resources allocated on the traditional safety and non-traditional safety function accounted for the proportion of the total military resources, MTS and MNTS represent military power protecting the traditional safety and non-traditional safety, so

$$ME = MTS \cdot p_{mts} + MNTS \cdot p_{mnts} \quad (2)$$

Among them ME represents total military resources, p_{mts} and p_{mnts} represents unit ensuring funds of military power protecting traditional safety and non-traditional safety.

Because what perform the ensure task of protecting non-traditional safety and traditional safety all are military power, having a homogeneous, so we assume $p_{mts} = p_{mnts}$, and assume unit military power ensuring funds is 1, then equation(2) can be simplified as:

$$ME = MTS + MNTS \quad (3)$$

M^* represents the minimum traditional safety threshold, and it can be replaced by the military power that resists to enemy's attack.

$$M^* = \beta_0 + \beta_1 \cdot M_1 \quad (4)$$

Among them M_1 represents the power of enemy; β_0 is military strategic parameters, represents anti-enemy conflict strategy: if it is passive defense, $\beta_0 < 0$, if it is initiative attack, $\beta_0 > 0$; β_1 is Lanchester coefficient that reflects military strength relative efficiency in the battle, so $\beta_1 > 0$; β_1 can also reflects our army's reaction degree to the change of enemy military power's change, so β_1 can be greater than, less than or worth to 1.

T^* represents the minimum non-traditional safety threshold, and it can be replaced by the non limit dealing result of the non tradition safety

$$T^* = \gamma_0 + \sum \gamma_i \cdot T_i \quad (5)$$

The T_i of equation (5) represent the i class non-traditional safety, and $T_i > T_0$ (T_0 is the boundary of IFM carried into execution, which is decided by the time and space dimensions); γ_0 represent the military operations policy to non-traditional safety; γ_i represent the non limit dealing coefficient of non-traditional safety.

Build the Lanchester equation as follow:

$$L = \alpha \log(MTS - \beta_0 - \beta_1 \cdot M_1) + (1 - \alpha) \log(MNTS - \gamma_0 - \sum \gamma_i \cdot T_i) + \lambda(ME - MTS - MNTS) \quad (6)$$

We can get the best military expenditure allocation to several safety threat:

$$MNTS = (1 - \alpha) \cdot (ME - M^*) + \alpha T^* \quad (7)$$

$$MTS = \alpha(ME - T^*) + (1 - \alpha)M^* \quad (8)$$

Equation (7) gives IFM's optimal scale. However, the implicit condition of this conclusion is that national safety mainly depends on the military strength flux. In fact, national safety depends on military strength stock.

We must add the time factor t, make the static model extend into dynamic model.

Our country's military power of stock K(including equipment and human capital) can be defined as total spending depreciation value in the past, represented as:

$$K(t) = (1 - \delta) \cdot K(t - 1) + MTS(t) \quad (9)$$

Among them, δ represents rate of depreciation, is a parameters remaining to be estimated. Because what this article researches is in peaceful stage, so the depreciation is passive rate, isn't damage in war. In the same way, we can assume enemy military power stock K_1 as the above, is

$$K_1(t) = (1 - \delta) \cdot K_1(t - 1) + M_1(t) \quad (10)$$

Next

$$S_1(t) = K(t) - (\beta_0 + \beta_1 \cdot K_1(t)) = MTS(t) - M^*(t) \quad (11)$$

Then we can redefine $M^*(t)$ as

$$M^*(t) = (\beta_0 + \beta_1 \cdot K_1(t)) - (1 - \delta)K(t - 1) = \beta_0 + \beta_1 \cdot [(1 - \delta) \cdot K_1(t - 1) + M_1(t)] - (1 - \delta) \cdot K(t - 1) \quad (12)$$

Then

$$MNTS(t) = (\alpha - 1)\beta_0\delta + (1 - \alpha)ME(t) + \alpha[T^*(t) - (1 - \delta) \cdot (MTS(t - 1) + T^*(t - 1) - ME(t - 1))] + (\delta - 1)\beta_1 \cdot M_1(t) \quad (13)$$

Equation (13) just is the optimal needing scale of IFM after considering time factor.

6. THE POLICY SYSTEM ARRANGEMENT ABOUT PROMOTING IFM FUNCTION

In theory, if the sum of the needing scale of IFM and money demand scale to deal with traditional safety threats is more than the budget constraints, then however we allocate resources, we always attend to one thing and lose another, being hard to make every safeties achieved. But in reality, this question doesn't exit. Because as far as every IFM practice, when army carry out operations other than war to deal with non-traditional safety threats effectively, the surroundings are still safe. But what still needs to be pointed out is that the function of IFM is low. Specific performance in allocation disequilibrium on time, money isn't enough in emergency support early, but latterly, there are a large number of supplies, then many supplies are unused; and allocation disequilibrium on space, it is mainly that money support on every unit carrying out operations other than war is unequal.

Specific performance in some areas have multi-channel supply is enough and has rest, but other areas don't have supply or are short of supply, on the one hand, it's waste; on the other hand, it's shortage.

Money stranded and shortage phenomenon exist at the same time, which causing allocation disequilibrium on space; inefficient functioning, money support appears for outages and hysteresis; wasting, there are repetitive purchase, uncontrolled cost, inefficient support, relax management and some other problems; out of line with the ensuring strength from non-military department.

To improve the function of IFM, on the one hand we need to build valid IFM management system.

This system must be in line with the comprehensive integration, quick response, such as structure distinct requirements.

To be specific, we should build a logistic support as the main body of the regional joint funding support system.

In this system, we can build all military (such as headquarters), regional (such as war zone) and action army three levels support institutions, each institutions, respectively, to raise, support, management, coordinating and other specific support duties.

In the current circumstances, we can build the combination of regional logistic and system support money support system as a transition system.

In the other hand, we should perfect the IFM management system. First, we need to formulate and perfect IFM plan, and its specific content includes money demand and limitation of cash reserves, support system, emergency response procedures, fund-raising channels, support pattern and choosing support way, setting support institutions and staffing, job duties and division of tasks, and emergency drill in peacetime, if need, we can also set non-traditional threat warning monitoring system; when we formulate IFM plan, we should make the procedures simplified, the content valid, the project detailed, the operation flexible, the start quick.

Second, we should establish the contingency reserve system.

As the preparing storage section of IFM, contingency reserve is mainly used to support the rapid raise additional materials equipment, and force needed for the shipping fees, early in the mission within a short time.

Third, formulate the standards for ensuring adequate funding scientifically.

The standards for ensuring adequate funding for scientific formulation are in charge of the general logistics department financial department jointly with the related business department.

The specific formulation should be combined with all precious spending data for performing different tasks.

Considering units at all levels, implements time of the task, labor intensity, and the difficulty of security factors. we should make all kinds of funds allocation, use and manage standards according to the principle “scientific and reasonable, easy operation, easy to manage” to formulate a standard system matched with the system.

Forth, create a new development fund model. Try to make the contingency plans to ensure and random security combined as well as logistic support and system guarantee, designated security and accompanying security, fund guarantee and physical guarantee, self-protection and assistance security.

We adopt the way of combination of for-some security and for-all security as well as emergency safeguard and security after, vertical guarantee and horizontal guarantee, temporary safeguards and common security, based on the factor of specific practice and the technical progress.

Fifth, clear the method of funds supply. In an ordinary way, we can take measures such as collecting and submitting an expense account, reimbursement for one’s actual expenses and all-in rate. Besides, in special cases, the method of responsibility to control is feasible. Sixth, build the coordination mechanism for ensuring adequate funding.

The main purpose is to strengthen the coordination of reverse fiscal mobilization and other main coordinating funds, as well as, behind the financial department and other professional service, funds safeguards action and combat command and synergy, and funds safeguards and local security forces.

Besides, we should take measures to strengthen financial management, strict supervision and control, update the information technology means, allocate, financial security equipment and train the ability of personnel quality.

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OPERATION AND MANAGEMENT ANALYSIS OF THE CIVIL-MILITARY INTEGRATION EQUIPMENT TECHNIQUE R&D

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Abstract: *The developing mode of the civil-military integration equipment technique R&D is an essential way for constructing and developing the PLA's equipment in the new stage. This paper presents three concrete modes for civil-military integration equipment technique. By constructing the civil-military integration equipment technique management framework with information, talents and fund as the cores, it aims to strength the cooperation of the civil-military equipment technique, use the military funds effectively and develops the national economy.*

Keywords: *civil-military integration, R&D, civil-military dual-use technique*

1. INTRODUCTION

Most of the countries in the world take the civil-military integration developing mode when advancing the development of the national economy.

According to the international security environment and national benefits, there exists military to civil, civil to military, or civil-military modes.

The CMI-NDSR investment in USA takes the military to civil mode, and carrying out Manhattan Project, Apollo Project, Star Wars Program, and Information Highway, etc, driving development of the nuke industry, aerospace, computer, GPS, and internet, etc. Japan takes the civil to military mode when driving the strategy of industrial development, aiming the future high technology and accumulating scientific and technological strength and powerful economy for national defense construction.

The Galileo project of Euro takes the civil-military global navigation service, not only driving the development of relative industry, but also improving the ability of defense and security guarantee.

There also are military-civil mode in Russia and military to civil in Israel, etc.

In the middle 1950s, Germany and Sweden started implementing the strategy of development and integration of defense technique and civilian technique. South Africa and USA implemented this strategy in 1960s and 1990s, respectively. It was implemented with the civilian technique development department as precursor and military technique development department supplying the funds, aiming to develop those industry. With the help of defense funds, a mass of civilian technique shifts to military technique in those countries. The strategy of France is to support the development of civil-military integration technique by national attention and concentrating funds, aiming to develop universal knowledge and technique.

2. THE CHARACTERISTICS OF CMI EQUIPMENT TECHNIQUE R&D

2.1 DIVERSITY OF THE INVESTMENT

SOURCE. CMI-NDSR is the integration of investment subject. In a long time, because most of the products supplied by the NDSR were public product, and the subject of the NDSR were government and military, and the fund source was national financial department, it resulted in the civil-military separation of the science research investment.

One content of the CMI-NDSR is diversity of the NDSR investment subject, including research investment on defense technique from government and military, and other economy subject in society. In the subject of NDSR investment, it is hard to separate civil and military absolutely.

One main characteristics of the CMI-NDSR is the diversity of the investment source, no longer following the national single investment subject. Because CMI-NDSR investment requires NDSR breaks self-sealing system and gradually introducing competitive mechanism, it inevitably requires opening multiple fund sources, forming stable, flexible and various NDSR investment mechanism.

2.2 DIVERSITY OF THE INVESTMENT

PURPOSE. CMI-NDSR investment is the CMI of investment purpose. In history, one technique was applied to military firstly and then was gradually applied civilian. Obtaining the leading position in defense technique indicates world leading in the science technique. So, pursuing advanced technique leads to extensive investment of NDSR. The purpose of this investment is very clear, for satisfying national defense technique requirement of the national defense construction. But from 1990s, the leading role of the national defense technique to civilian technique was changed.

In some fields, civilian technique led national defense technique, and produced large economy and social benefits, and CMI-NDSR was the result for copying this change.

The purpose of the CMI-NDSR is not only limited to traditional national defense science technique and single need of the national defense science technique, but also based on the development of the science technique and invests to those with vast application prospect, and having huge influence on civil and military field.

The purpose of the investment is to consider the final military, economy and social benefits by all aspects.

The CMI investment usually chooses high and new techniques with wide universality and application, for realizing mutual-use.

For example, in recent years, the rapid development of strategy industries show these characteristics and investment in these fields can be regards as model of CMI-NDSR.

Take the new information technique industry as example, the new generational mobile communication, the next internet, the internet of things, geographic information, high performance integrated circuit and highpoint software, etc, play important roles in driving national economy and social development, and have wide application in defense and military construction.

It is estimated that 80% of computer, military microelectronics and photoelectronics needed in developing information army is universal with civilian technique.

As the Beidou navigation system is built, the annual value of production is 50 billion, including 95% civilian customs.

Another example is space industry in developing high point equipment manufacturing industry.

It needs collective breakthrough in new material, modern manufacture, advanced power, electronic information, auto-control and computer, and has important effect on developing economy, improving livelihood and changing flight force.

2.3 THE CMI-NDSR INVESTMENT IS AN EQUILIBRIUM CONCEPT. From one aspect, the CMI-NDSR doesn't mean the investment subject including civil and military all the time. It doesn't exclude the single source of one investment subject. It means from the viewpoint of the nation or region, in the current NDSR investment, it is from government and military, and it also can be from private company. It emphasizes an idea, i.e., the NDSR is not a single action from military or civil. In the other aspect, the NDSR doesn't mean there coexists military and civil each time, not excluding some specific investment which is regarded as military or civil. It means from the view of the whole level, the investment from the nation or private company on technology has CMI universality. It emphasizes this thought, i.e., the NDSR is not only satisfying the need of civil or military, but also facing the technology having important application and universality.

3. OPERATION MODE ANALYSIS OF THE CIVIL-MILITARY INTEGRATION EQUIPMENT

National defense scientific research investment in military and civilian integration type development needs to take certain patterns, "pattern" can be understood as a way, specific to a project for the research and development, should take in what manner, namely the stakeholders should have what kind of ownership structure, the most reasonable, such as by a single way of the government or the army to public spending, or spontaneous investment of private enterprise, or a combination of both.

Due to the cause of national defense scientific research investment model that the root cause of the differences is the different characteristics of the expected results of defense equipment technology investment, therefore, the military and civilian integration, analyzing the running mode of the national defense scientific research investment is carried out according to the national defense technology equipment and general strength. Army generally contain asset specificity and equipment technology and correlation.

3.1 MILITARY TO CIVIL. With the end of the cold war and the development of global economy, national defense technology development investment presents new characteristics, besides a few countries such as the United States, Russia, most of the countries in the world military technology development costs into a trend of gradual decline, in this situation is mainly civil defense technology transformation, military equipment technology R&D mainly embedded in civilian technology R&D. People turn to the operating mode is aimed at has lower asset specificity and the low correlation with the existing national defense science, technology and industry of national defense science and technology research and development investment, this type of investment can take the military requirement "embedded" to the corresponding civil related technologies in the field of development, the investment main body of the source can be mainly depends on the related to the private sector in the field of civil, caused by private sector investment related to the development of military technology. This type of national defense scientific research investment is expected to produce technology in the field of civil already has a foundation, and the related technology in the field of civil ahead of the existing military technology, has a more extensive military application prospect, usually is not involved in defense science, technology and industry.

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By the private sector to complete this type of national defense scientific research investment, can play a military requirement to civil investment of science and technology in the field of stimulation and drawing function, also can save the government department of national defense scientific research investment, reduce the national defense construction of the "crowding out" of economic construction, to realize the harmonious development of national defense construction and economic construction.

Therefore, for the national defense equipment technology have the characteristics of low dependence, low specificity of national defense scientific research investment, can use a general research and development of embedded in the corresponding civil technology development process, to demand as the breakthrough point, demand integration, paying equal attention to capital integration and technology integration.

3.2 CIVIL TO MILITARY Conversion mode refers to the defense of the invention or technology transfer to civil economy, it includes information and data related to the defense department R&D activities such as science and technology to develop other resources.

Conversion assumes defence R&D technology is superior to the civil commercial technology, and there are a large number of idle resources, military defense resources actively to in the production and development of the civil economy.

Conversion mode for high degree of asset specificity, or high correlation between the existing national defense science, technology and industry and national defense science and technology research and development investment, the purpose of this type of investment mainly to meet the current and future a period of military requirement is given priority to, its efficiency has not been reflected in the field of civil, the main body of investment mainly relying on the public sector,

relying on the existing national defense science, technology and industry as the main body.

High degree of asset specificity, or high correlation between national defense science, technology and industry and national defense scientific research investment, usually invest in frontier technology, high degree of project risk, high investment, long cycle and the expected economic benefits short-term hard to work, private capital is often unable to undertake this task, and based on the existing national defense science, technology and industry, funded by the public sector as the main body, to ensure that project in the long-term, sustained the source of funds and improve the chances of success technology research, to ensure that a country's core military technology in certain areas of the world's advanced level.

Even some has a wider civil application prospect in the field of project, due to its high asset specificity, relying on the existing national defense science, technology and industry can easily realize "conversion", reduce the repeated construction and waste of resources, improve the efficiency of resource allocation.

Therefore, the military dependence strong national defense scientific research investment should be taken to give priority to with the existing national defense research and development department "relating to" mode, to capital as the breakthrough point, demand integration and capital integration and technology integration

3.3 CIVIL TO MILITARY The CMI mode refers to the research and development in the national economy can not only support the development of the civilian technology can support the development of military technology jointly by the technical foundation, the technology basis for defense manufacturers into the civilian economy diversify investment opportunities, and develop the business technology is widely used in military field.

Civil-military R&D cooperation mode is aimed at moderate degree of asset specificity, or medium correlation of defense science and technology research and development investment, this type of investment can take demand for military and civil common development way, the main body of investment according to their respective comparative advantages, by the public sector and private sector were completed or joint venture.

This type of national defense scientific research investment is expected to produce technology in the field of civil and military field have a certain degree of development, but because of the different emphases, the respective comparative advantage is not the same.

Jointly by public and private sectors, paid for this type of investment, can play to the advantages of private capital to pursue efficiency, also can use public capital anti-risk ability strong advantage.

Only so can produce this type of national defense scientific research investment mode, because in the process of development, science and technology used in the field of military or civilian often exist in the field of time difference, and under their demand for technological innovation also gradually change, formed have advantages of each technology.

As a result, those of medium degree of asset specificity, and the correlation technology and industry for national defense of national defense scientific research investment for "civil-military cooperation" mode, as the breakthrough point, to technology fusion technology integration, the demand and capital merge three equal attention

3. CONCLUSIONS & ACKNOWLEDGMENT

Turn from the people for R&D of defense forces, military, military and civilian R&D cooperation mode analysis is easy to see that people turn to the mode and the conversion model is the product of the cold war, it will be the national economy artificially divided into separate two departments, compared to the civilian economy, national defense economy is a kind of external economy, free from the civilian economy, in the national economy to burn a lot of limited economic resources and human resources, and shall enjoy the right of priority configuration in the allocation of resources.

Although defense economy could overflow of finished goods, but the overflow is accidental and uncertain, and military resources transformation (conversion) has high switching costs and the transformation of a certain risk.

By contrast, the R&D of defense mode of dual-use, reflects the national defense economy and a potential relationship between the civil economy, it will be two department economic organically unifies in together, become a part of the national economy blend mutually.

Civil defense economy, economic integration, in some cases, the national defense foundation to support the implementation of national strategy, and defense for civilian economy market-oriented operation, so that more efficient, more economical to complete the country's military mission.

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RESIDUAL CLAIM, TECHNOLOGICAL BOUNDARY AND OPTIMAL INVESTMENT ARRANGEMENT: THEORETICAL MODEL AND CONTRACTUAL EXPLANATION

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Abstract: *The segmentation of residual claims, is one of the dynamic mechanism of defense R&D investment. Based on two dimensions of risk measuring and motivation designing, the contracts of defense R&D investment should be taken into an arrangement of division. In this paper, a mathematical model is set up to describe the nature of investment contract. Through arithmetic analysis, six key conclusions should be focused on, aiding to reveal the relations among the factors such as investment quota, effort coefficient, R&D yield, incentive effect and technological innovation. The further measuring on variables such as k , r and c indicates that both the specificity of defense R&D investment and hold-up behavior of military firms make it hard to break up k effectively. There exists a boundary where equilibrium of k and r should be located in the R&D projects with the highest intrinsic value, and the share of c should be accorded to the adjustment of r . By analyzing the variables δ and θ , it emphasizes the possibility of hidden dissipation of investment and the feasibility of step-by-step investment. Finally, some suggestions on the contract rights, contract forms, risk sharing, diversification of investment, technical boundary and management system of are put forward.*

Keywords: *residual claim, investment specificity, hold-up, investment boundary, implicit dissipation, technological innovation*

1. INTRODUCTION

The economic distribution is commonly performed by contract in the market. There are mainly three types of contracts according to the distribution forms, i.e. the wage contracts, the fixed contracts and the sharing contracts. For the wage contracts, the principal pays a fixed salary for the agent, possesses the rests and bears all risks. For the fixed contracts, the agent pays a fixed rent for the principal, possesses the rests and bears all risks. For the sharing contracts, the principal will pay a proportion of residues besides a definite sum of money. When analyzing the issues of agricultural production, Cheung (1969a, 1969b) points out that given a clear ownership, there will be no difference between the sharing contract and the fixed contract on the resource allocation, and the choice on the contractual form by both sides relies on the transactional cost and the attitude towards risk.

Essentially, the sharing contract can be regarded as a contractual mechanism for risk diversification (Cheung, 2000). This thought is profound for it has not only thrown down the traditional idea that the sharing contract produces efficiency loss, but revealed its function on the risk diversification. However, it does not consider the supervision cost and ignores the significance when the share-cropping plays an incentive role. By creating an initial efficiency-wage model, Stiglitz (1974) has modeled the thought of Cheung and considered that the ratio of the sharing does have an incentive effect on the labor. A technical process of which is to embed an effort coefficient into the production function and the utility function. The model analysis in this paper has referred to this paradigm.

The core of contract is to pursue for the residual claim for both sides. The so-called residual claim here means a claim for the residue when total revenue minus the fixed contract payment.

Residual claim, technological boundary and optimal investment arrangement: theoretical model and contractual explanation

Thus, the allocation issue of residual claim has been the focus of the theory of firm. When explaining the corporate internally incentive mechanism (considering the supervision cost), Alchian & Demsetz (1972) emphasized the importance of residual claim on stimulating the supervisors. The reason why the defense R&D investment would adopt the sharing contract is that both the risk and incentive must be thought about. The long period and low success, as well as the multi-category-small-amount operating procedure, have together enhanced the cost and risk of defense industrial firms. Meanwhile, the irreversibility of investment demands the investor should pay a large sunk cost and request for a cost compensation inevitably. And the immeasurableness of the efforts of the firm makes the investment contract incomplete. When the outsider (for instance, the investor) lacks the incentive to supervise the firm, the problem of insider control that will not exist in a classical firm will emerge. Here, the insider control will bring about a huge residual loss, which ensures the existence and necessity of the arrangement of residual claim.

2. THEORETIC MODEL

2.1 Basic framework. In the defense R&D investment, we assume that the investor (I) owns the residual claim for R&D yield π of the military firm (F), which is mainly based on three aspects: Firstly, there will be uncertainties within the investment environment and investment project (here ε represents a random state), and the risks of investment result needs some compensation mechanism to smooth up. Secondly, the investment has a remarkable specificity, and a huge investment will result in a big cost viewed from the perspective of scale effect. Thirdly, the elasticity of rate of residual sharing or rate of return on investment (for I) can produce positive incentives, promoting the military firm to enhance its effect level of R&D (ω), here $1-r$ is the remaining share of F, and

$$\frac{\partial \omega}{\partial r} < 0.$$

Consuming that both I and F have a fully defined utility function, the total revenue of defense R&D can be described as (ignoring the influence of tax)^[1]:

$$\pi = \pi(\omega, k, \varepsilon) \quad (1)$$

Supposing that π is a monotonically increasing concave function of ω and k , and is an increasing function of ε , namely $\frac{\partial \pi}{\partial x} > 0$,

$$\frac{\partial^2 \pi}{\partial x^2} < 0, \text{ here } x = \omega, k, \frac{\partial \pi}{\partial \varepsilon} > 0.$$

And ε obeys the normal distribution with mean of 0 and variance of σ^2 , namely $\varepsilon \sim N(0, \sigma^2)$.

The arrangement of revenue sharing can be described as a form of piece wise linear contract^[2]:

$$\pi_F = f + (1-r)(\pi - f - g) = \frac{\partial \pi}{\partial k}(1-r)k \quad (2)$$

$$\pi_G = g + r(\pi - f - g) = \frac{\partial \pi}{\partial k}k \quad (3)$$

Here, the functions f and g are respectively the fixed items in the investment contract. $\frac{\partial \pi}{\partial k}$

stands for a marginal benefit of investment. The Eq. (2) is a general expression on the income -determining terms in the three contract forms. Obviously in the wage contract, $r=1$, while $r=0$ in the fixed contact and $r \in (0,1)$ in the sharing contract.

According to Hart & Holmstrom (1987), the optimal contract under the condition of an information asymmetry and an assumption of risk neutral (a lack of understanding about ε and a high supervising cost): $f=0, r=0$. Namely, the firm holds the whole residual income, and the investor obtains a fixed earning. But in fact, there exist three constraint conditions making the optimal contract unenforceable. The first one is a lower bound. For whatever contract must at least provide the factor-owner with an original value, otherwise the latter will quit the contract (Cheung, 1983). For the investor, g may be too small to make up for the transaction cost; while for the military firm, $f=0$ means there is no guarantee for a basic operating cost.

The second one is an incentive constraint. $r=0$ i.e. $\pi_G = g$, means that the investor will merely get a fixed income. If the investment is a kind of approximate market-pulling behavior, g will be even less likely than the opportunity cost of k , which will lead to an inadequate investment due to insufficient incentives. The third one is a risk constraint. The contract terms, technical strength and defense demand etc., will all pose an external impact on R&D, bringing about a unchangeable risk aversion for the military firm in many occasions. But the constraints in a fixed contract will make the military firm bear most of the risks. Thus, the extreme contractual arrangement with $f=0$ and $r=0$ doesn't evidently conform to the risk hypothesis for R&D investor. The only viable contractual solution is $0 < f < \pi, 0 < r < 1$.

Assuming that the investor is risk neutral^[3], whose utility function is:

$$\mu_G = \pi - \pi_F = \pi - \frac{\partial \pi}{\partial k}(1-r)k \quad (4)$$

And its certainty equivalent income is equal to the random average income, that is:

$$E(\mu_G) = E(\pi - \frac{\partial \pi}{\partial k}(1-r)k) = \pi - \frac{\partial \pi}{\partial k}(1-r)k \quad (5)$$

Assuming that the utility function of military firm is $\mu_F = -\exp(-\rho \xi)$, here ρ is the absolute risk aversion, ξ is the actual yield. If the military firm plays an effort level of ω , it will lower a (currency) cost of ω for the R&D project, and give rise to a negative utility of $\psi(\omega)$. Here $\psi(\omega)$ is a monotone increasing convex function of ω ,

that is for any $\omega > 0$ ^[4], $\frac{\partial \psi}{\partial \omega} > 0, \frac{\partial^2 \psi}{\partial \omega^2} > 0$.

To simplify the analysis, we assume that

$\psi(\omega) = \frac{\tau}{2}\omega^2$, here $\tau > 0$ means an effort cost

coefficient. ξ meets:

$$\xi = \pi_F - \psi(\omega) = \frac{\partial \pi}{\partial k}(1-r)k - \frac{\tau}{2}\omega^2 \quad (6)$$

Its certainty equivalent gain is:

$$E(\mu_F) = E(\xi) - \frac{1}{2}\rho(1-r)^2\sigma^2 = \frac{\partial \pi}{\partial k}(1-r)k - \frac{\tau}{2}\omega^2 - \frac{1}{2}\rho(1-r)^2\sigma^2 \quad (7)$$

For any sharing contract with a two-dimensional vector of (f, r) , the military firm will choose an optimal effort level ω to maximize the utility function:

$$\text{Max}_{\omega} E(\mu_F) = \frac{\partial \pi}{\partial k}(1-r)k - \frac{\tau}{2}\omega^2 - \frac{1}{2}\rho(1-r)^2\sigma^2 \quad (8)$$

Give Eq. (8) a first derivation:

$$\omega = \frac{(1-r)k}{\tau} \frac{\partial^2 \pi}{\partial k \partial \omega} \quad (9)$$

Eq. (9) implies a conclusion: because

$\frac{\partial^2 \pi}{\partial k \partial \omega} > 0$, there is a positive relationship between

k and ω , meaning that the defense investment has a positive incentive on the military firm.

At this moment, what the defense investor would solve is:

$$\text{Max}_{s.t. r \rightarrow \text{Eq. (9)}} E(\mu_G) = \pi - \frac{\partial \pi}{\partial k}(1-r)k \quad (10)$$

Clearing up the first-order condition^[5] based on Eq. (9), we will get (on account of $0 < r < 1$, the interior point solution exists):

$$r = 1 + \frac{\frac{\partial \pi}{\partial \omega} \frac{\partial \omega}{\partial r} \tau}{\left[\left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 k^2 + \rho \tau \sigma^2 \right]} \quad (11)$$

Adding it to Eq. (9):

$$\omega = -\frac{\frac{\partial \pi}{\partial \omega} \frac{\partial \omega}{\partial r}}{\frac{\partial^2 \pi}{\partial k \partial \omega}} k \left/ \left[\left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 k^2 + \rho \tau \sigma^2 \right] \right. \quad (12)$$

2.2 Some deductions. From Eq. (9), we can get:

Proposition-1: $\frac{\partial \omega}{\partial (1-r)} = \frac{k}{\tau} \frac{\partial^2 \pi}{\partial k \partial \omega} > 0$ indicates

that in the investment contract, to increase the share of residual claim of military firm will benefit to reduce the risk of moral hazard under asymmetric information, stimulate the initiative and creativity of military firm engaged in the defense R&D.

Proposition-2: $\frac{\partial (1-r)}{\partial \tau} = \frac{\omega}{k} \left/ \frac{\partial^2 \pi}{\partial k \partial \omega} \right. > 0$ indicates

that the bigger effort cost coefficient τ , the more the share of residual claim required by the military firm for its effort level ω .

Residual claim, technological boundary and optimal investment arrangement: theoretical model and contractual explanation

Because of the risk of defense R&D, the military firm will inevitably require a certain cost compensation or expected return.

Proposition-3: $\frac{\partial \omega}{\partial \tau} = -\frac{(1-r)k}{\tau^2} \frac{\partial^2 \pi}{\partial k \partial \omega} < 0$ and

$\frac{\partial^2 \omega}{\partial \tau^2} = \frac{2(1-r)k}{\tau^3} \frac{\partial^2 \pi}{\partial k \partial \omega} > 0$ indicate that in the

contractual arrangement, the investor should fully think about such a possibility: a bigger τ will lead to a lower effort efficiency of military firm, which is a multiplicative decrease^[6].

From Eq. (11), we can get:

Proposition-4:

$\frac{\partial(1-r)}{\partial \rho} = \frac{\partial \pi}{\partial \omega} \frac{\partial \omega}{\partial r} (\sigma^2)^2 \left/ \left[\left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 k^2 + \rho \tau \sigma^2 \right]^2 \right. < 0$ and

$\frac{\partial(1-r)}{\partial \sigma^2} = \frac{\partial \pi}{\partial \omega} \frac{\partial \omega}{\partial r} \rho^2 \left/ \left[\left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 k^2 + \rho \tau \sigma^2 \right]^2 \right. < 0$

indicate that the stronger tendency to avoid risk for the military firm, the greater uncertainty within the external environment of defense R&D, as well as the greater risk the investor will bear, resulting in a lower percentage of return for the military firm. In this case, the incentive mechanism will be out of order. By this time ($\pi_f \rightarrow f$), namely the fixed contract regardless of the R&D efficiency will be superior to the incentive contract based on the residual claim. On the contrary, for $\sigma^2 \rightarrow 0$, in order to reduce the uncertainties within the external environment of defense R&D, the incentive effect will be more obvious in the linear contract (Eq. (2)).

Proposition-5:

$\frac{\partial(1-r)}{\partial k^2} = \frac{\partial \pi}{\partial \omega} \frac{\partial \omega}{\partial r} \left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 \tau \left/ \left[\left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 k^2 + \rho \tau \sigma^2 \right]^2 \right. < 0$

indicates that the greater is the investment, the bigger is the residual claim scale of the investor asks for. Namely, the less is the profit share of the military firm, and the less is the efforts input. Therefore, there undoubtedly exists an equilibrium solution of k and r in the optimal contractual arrangement, which will be analyzed in the third part.

From Eq. (12), we can get:

Proposition-6:

$$\frac{\partial \omega}{\partial \sigma^2} = \frac{\partial \pi}{\partial \omega} \frac{\partial \omega}{\partial r} \frac{\partial^2 \pi}{\partial k \partial \omega} k \rho \left/ \left[\left(\frac{\partial^2 \pi}{\partial k \partial \omega} \right)^2 k^2 + \rho \tau \sigma^2 \right]^2 \right. < 0$$

indicates that the smaller is the risk of R&D project, the easier it guarantees an effective output, and the higher is the enthusiasm of the military firm. To avoid a loss caused by a misguided decision-making, the military firm tends to choose a normal investment project with a lower market risk. And thus, the R&D project focuses mainly on the level such as a blind imitation or a tracking innovation, giving rise to a low-level repetition of research achievements, a low contribution rate technological progress acts on the generation & transformation of fighting capacity, as well as the coexistence of the shortage & redundancy of the R&D achievements.

3. THE OPTIMAL CONTRACT ARRANGEMENT

The second part is mainly to measure mathematically about the internal relation among the variables of the defense R&D investment.

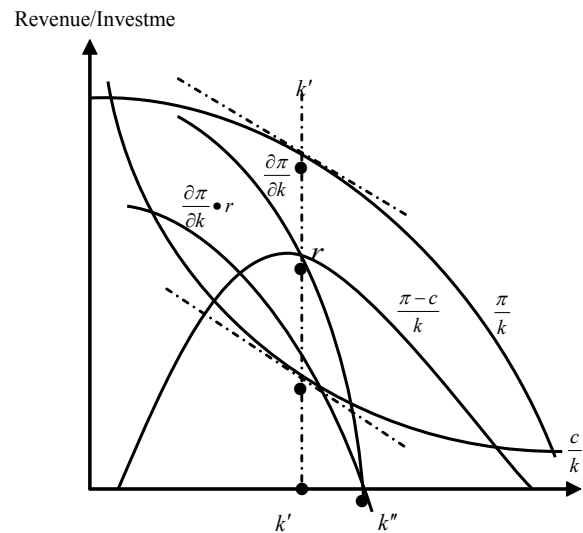


Figure-1. Graphic Description of Contract Arrangement of Defense R&D Investment

The third part will give a further analysis on Eq. (2) and (3).

We will introduce a two-dimensional coordinate system to diagrams the relevance of k , r and c , so that we can obtain an optimal contractual arrangement of the defense R&D investment on the two dimensions of both revenue sharing and cost compensation.

3.1 Diagrammatizing. The key variables in the graph explained:

- $\frac{\pi}{k}$ means the average revenue of the

R&D investment of military firm.

- c means the R&D input of military firm (except of the investment itself), including the plants, equipments, labor inputs, etc. Assuming that all the R&D input (except of the investment) c must be borne by the military firm (Later we will relax the conditions) and

remain unchanged, so $\frac{c}{k}$ can be regarded as a

quotient of the non-investment and investment, or a necessary ratio of the complementary cost to the investment k , which is manifested as a hyperbola convex to the origin in mathematics.

- The vertical dimension between the

curve $\frac{\pi}{k}$ and $\frac{c}{k}$ defines the curve $\frac{\pi-c}{k}$, i.e. net

revenue per investment.

- $\frac{\partial \pi}{\partial k}$ means the marginal revenue of R&D

investment. When c is fixed, $\frac{\partial \pi}{\partial k}$ decreases with

the increase of k , namely $\frac{\partial^2 \pi}{\partial k^2} < 0$.

- The contractual arrangement on residual sharing of the investment revenue: On

the marginal, the investor asks for $\frac{\partial \pi}{\partial k} r$, and the

military firm gets the rest $\frac{\partial \pi}{\partial k} (1-r)$.

The every moving-up of the curve $\frac{c}{k}$, will

cause the responding moving-up of the

curve $\frac{\pi}{k}$.

The former means the marginal cost of non-capital increases with a constant rate (the marginal cost of factors remains the same). The latter shows that the marginal revenue of added non-capital input increases with a diminishing rate. When the marginal distance is equal for the both curves, the marginal revenue will equal the marginal cost of the R&D investment (the two virtual tangents parallel), so the marginal

revenue curve $\frac{\partial \pi}{\partial k}$ will intersect both the

average revenue curve $\frac{\pi}{k}$ and net revenue per

unit curve $\frac{\pi-c}{k}$. This moment the balanced

investment assigned to military firm is k' , and the balanced revenue sharing rate r

equals the ratio of $\frac{\pi-c}{k}$ (or $\frac{\partial \pi}{\partial k}$) and $\frac{\pi}{k}$, which

can describe the residual sharing $\frac{\partial \pi}{\partial k} r$ of the

3.2 Investment division: a balanced measuring of k and r . By definition, the R&D

revenue of military firm $\frac{\partial \pi}{\partial k} (1-r)$ will change

with k . If this revenue is not less than that coming from the R&D activities, as long as

$\frac{\partial \pi}{\partial k} > 0$ and c remains constant, the military firm

has have an incentive to continue the defense R&D, and improve the utilization efficiency of investment as much as possible. On the other hand, in order to achieve a maximum revenue, the investor will require a higher sharing ratio

r which enhances the curve $\frac{\partial \pi}{\partial k} r$, until the R&D

revenue of military firm equals its non-R&D possible revenue. Actually, r is not the sole relevant variable affecting the residual sharing of the investment contract. when investigating the agricultural tenancy agreements, Cheung (2000) points out that If the tenant market as a buyer is unceasingly subdivided, that is to say, the landlord offers his farming lands to different peasants to obtain a maximal rent, he will not has an incentive to sign a long term contract only with the same tenant farmer.

Residual claim, technological boundary and optimal investment arrangement: theoretical model and contractual explanation

According to the contract theory, such one-to-many relationship is in essence a kind of filtering mechanism. For once the number of buyers increases, the available allocation amount must be reduced, which demands to lower the ratio of the lease, in order to prevent that the buyer should quit the contract^[7]. However, the reduction of the lease rate will decrease the final revenue of the seller. Therefore, a trade-off exists in the both.

In terms of the defense R&D investment, if the investment k is split for many military firms and we assume that all the r is equal, there will be several vertical investment boundaries $k'k'$ in the figure. Compared with a sole military

firm, the curve $\frac{\partial \pi}{\partial k}$ will move up, but due to

a deducing investment quota for sole military firm, the marginal expected revenue of the investor, $\frac{\partial \pi}{\partial k} r$, will inevitably decrease.

Moreover, once the line $k'k'$ continues to shift to the left, r will eventually become very low (at this time, a undersized investment k' can't meet the fund demand of defense R&D, neither bring forth a scale effect of output.), thus reduce the total investment revenue. Another explanation that there is seldom contract term of investment division in practice, could be due to the properties of the investment itself, namely the investment-specific has an internal stimulation on the investment boundary. According to Klein (1978), et al., the investment-specific is something that once used to other realms, its marginal productivity will be close to zero. Actually, the defense R&D investment is not less than a sort of relationship-specific investment in the Williamson's sense (1975). That is, the investment specially used for the military firm to carry through the defense R&D, whose economic intuition is quite simple: because of the uncertainty of the R&D revenue π , as well as the difficulty in measuring the performing cost, once one party invests on a project with a high investment-specific, he will objectively be faced up with the opportunistic hold-up from the other party (military firm).

The hold-up is a function of decision-making right λ of military firm^[8], such as account manipulating, investment eroding, and even the power rent-seeking^[9].

In other words, the degree of investment-specific will give rise to a non-efficiency consequences.

As for the investor, he will pay an additional follow-up governance cost when lending the investment, especially when the technical strength θ and effort degree ω of the buyer (military firm) are both small, the adverse selection and moral hazard occur easier and the regulation becomes more difficult^[10].

The better transmission the defense R&D acts on the fighting capacity, the higher investment-specific of the investment, and the more tendency for the investor to disperse risks by expanding the investment boundary.

The expansion modes is mainly to diversify the invests and projects, but it also brings about an increase of the transaction cost.

Particularly as for the former, the three important variables θ , ω and λ , are difficult to be clearly defined in the contract.

3.3 The investment interval: measuring the point of intrinsic value. As a supplement to the investment division, we analyze here the investment interval. From the definition and the graphic we get:

$$\frac{\partial \pi}{\partial k} = \frac{\pi - c}{k} \Big|_{k = k'} \quad (13)$$

At the peak of curve $\frac{\pi - c}{k}$, the marginal

investment revenue is equal to the average net investment revenue, which is a basic principle of the firm theory. According to the theory, the line $k'k'$ is a reasonable interval of the investment.

While the radical difference between the contract theory and the cost theory when adjudging the investment interval lies in that, the latter only aims at the firm itself, while the former includes two participants, whose purposes do appreciably differ.

Therefore, the investment interval $k'k'$ will likely withdraw to be an equilibrium point k' .

Three points here should be explained:

(1) The military firm is more inclined to the investment k'' , which is more than the

equilibrium investment k' , for $\frac{\partial \pi}{\partial k} = 0$ meets the

condition of revenue maximization. (2) Based on the same reason, the investor will control the investment at k' , and loan the rest investment $k'' - k'$ to other firms in the same contract terms. (3) The investor cannot control the investment below the level k' , for when r is given, the opportunity cost when the military firm accepts the investment may be higher, lacking of the incentive to continue the R&D project.

For the sharing contract, how to make the financing scale k and the net investment revenue

$\frac{\pi - c}{k}$ of military firm reach to an equilibrium?

The investment must be used on the R&D projects with the highest intrinsic value, and the input of military firm must be fully taken into account. As long as the market is flowing and competitive, the investor does not need to grasp at the technological input and innovation of the military firm, for the competitiveness of the freely flowing capital can lead to an effective contractual arrangement. Obviously, if the

intrinsic value ($\frac{\pi - c}{k}$) of R&D project is low,

the irrational impulse when the military firm absorbs investment will easily lead to a

high k or a small c . In this case, $\frac{\pi - c}{k}$ will less than

the average interest rate of the market, which is obviously unfavorable for investor. What the investor can do is either to loan the investment to other military firms, or to invest other R&D projects. On the other hand, if what the military firm obtains from the sharing contract is less than the opportunity revenue from other economic project, he will choose voting with feet and seeking for another investor with more

favorable terms (a higher k and a lower $\frac{\pi - c}{k}$).

3.4 The separability of c : an idea for cost sharing. The cost of defense R&D (not investing cost) can be shared by the investor and

the military firm. Here, $\frac{c}{k}$ stands for a merged

cost. When the curve $\frac{\pi}{k}$ and $\frac{c}{k}$ are both given,

the curve $\frac{c}{k}$ minus this segmental cost of the

investor will lie in a lower area, while the

curve $\frac{\pi - c}{k}$ is higher (not drawn up). By this

time, r will be higher and the curve $\frac{\partial \pi}{\partial k}$ will

move up at the same speed, while the equilibrium investment k' will keep constant.

Certainly, the peak of a higher curve $\frac{\pi - c}{k}$ will

shift to the left of the dotted equilibrium line $k'k'$. While this has nothing to do with the choice of investment scale, for it will result in a lower sharing rate r . From Eq. (13) and the basic definition, we can easily deduce:

$$r = \frac{\partial \pi}{\partial k} / \frac{\pi}{k} = \frac{\pi - c}{k} / \frac{\pi}{k} = (\pi - c) / \pi | k = k' \quad (14)$$

Eq. (14) shows that in order to effectively use resources, the sharing of cost c can be adjusted according to the revenue sharing rate r .

This conclusion has an important policy meaning: Whether the investor asks the military firm for more input and less profit (lower r), or the investor himself pays more cost and asks for a higher r , he will invest in some way as provided an investment maximization. The above analysis provides a sort of means for the contractual design of the defense R&D investment: the military firm doesn't need to own the total input for the R&D project, while he can cooperate with the investor or the third party when lacking of the input, by means of joint developing, technology importing and practicing joint venture. From the perspective of capital market, the military industrial groups relies on the asset restructuring, merger& acquisition and industrial integration, as well as introducing diversified capital and operation mechanism, which will be the largest investment opportunity for the military industry listed companies in the future.

4. FURTHER THINKING: EMBEDDING PARAMETERS

According to the neo-classical optimal growth theory, the traditional production function $Y = Y(K, L)$ includes two independent variables, and the technical progress is always regarded as a Harrod neutrality. The benefit of doing this is that it seldom causes any additional difficulty when analyzing, but at the same time it ignores explaining the origin of technological progress. Within the defense R&D, the technological progress or innovation is a transitional factor, for its ultimate goal should be to enhance the productivity and transform the generation mode of fighting capacity. As mentioned before, the defense R&D is a dynamically progressive process, whose technology is an input for the follow-up phases. For the investor, it is appropriate that the technology θ of defense R&D be regarded as an important reference. To make up for such a loss, it is necessary to make the technology endogenous. The Learning by Doing model by Arrow (1962) regards that the investment is a measuring of Doing (here interpreted as the defense R&D) and Doing leads to Learning (technological progress). Shell (1966) has proposed a model to prove that the accumulation of knowledge (technology) depends obviously on the resource endowments of the invention activities (defense R&D). We here put forward a simplified formula for an endogenous θ based on Shell's model:

$$\begin{aligned} \dot{\theta}(t) &= (1 - r(t)) \pi(t) - \theta(t) \\ \dot{k}(t) &= r(t)\pi(t) - \frac{\partial \phi}{\partial \lambda} k(t) \end{aligned} \quad (15)$$

Eq. (15) has processed technically for three sides: Firstly, describing the relation between the technology and capital input and the revenue π within a dynamic framework. Secondly, reflecting the time effect of investment sharing rate r , which mainly considers that the defense R&D investment may be multi-stage and continuous, and there exists a possibility revising the terms of contract for both parties. So the determination of r is dynamic.

Thirdly, the imbedding of erosion coefficient $\phi(\lambda)$ is to measure the implicit dissipation of

investment. Here, $\phi(\lambda) \in (0, 1)$, $\frac{\partial \phi}{\partial \lambda} > 0$. The military firm has the information

superiority upon decision-making. Once the freedom λ increases, namely the investor cannot guarantee the validity of investment on regulating, the military firm will occupy and erode the investment, resulting in an investment

dissipation with $\frac{\partial \phi}{\partial \lambda} k$.

5. CONCLUSIONS

5.1 The free exiting mechanism for the investor should be an option in the contract.

The defense R&D investment contract can be considered as a kind of implicit long-term one for both participants^[11]. Presently, the identity of investor is strictly limited. Most of the time, the paternalism of government will lead to a under use of the investment, and the behavior restriction of defense R&D tends to soften. One immediate consequence of the soft budget constraint is that the military firm is inclined easily to have a moral hazard syndrome, such as abusing investment, encroaching capital, misreporting profit and loss and malignant subsidizing, therefore the rights of the investor cannot be effectively protected.

The tenancy theory points out that, as long as the land owner has the power to decide whether to maintain the original contract, the tendency of declined revenue of tenant farmer under the share-cropping could be suppressed. This implies that, a contractual term of free exiting endowing for the investor (potential threat could also work) would guarantee a sound performance of military firm who would maintain a soaring zeal, thus reducing a potential investment dissipation. Therefore, as a hedging mechanism, the right to exit for the investor should be a clause of the contract.

5.2 A full consideration on the feasibility of segment-based investment.

From another perspective to interpret the moral hazard syndrome of military firm, the investment-specific of defense R&D investments leads to a high opportunity cost of one-time investment, and increases the risk of investor.

The implicit contract between the investor and military firm will evolve into an insurance contract. Especially when the former cannot take an effective anti-hold-up step against the opportunism of the latter, the self-enforcing of military firm could not be institutionally guaranteed. That is to say, the investment-specific increases the probability of the moral hazard of military firm, and weakens the feasibility of the exiting of investor. As a complementary mechanism of the above exiting, a one-time investment of the contractual term may be rewritten as a segment-based investment given a unobtrusive transaction cost, whose purpose includes: (1) weakening the investment-specific; (2) increasing the negotiable room for revising r ; (3) reducing the information asymmetry. In this case, a positive incentive mechanism for military firm could be enforced, and the exiting term could also be an internal constraint for the self-enforcing of military firm.

5.3 On the basis of revenue sharing, establishing risk sharing mechanism of defense R&D. A feasible way is to add an escape clause into the iron-sheet contract, namely the revenue π or sharing rate r is allowed to be discounted at some special intervals (such as a structural technical bottleneck on the R&D project, a rapid increase of input c caused by the market change etc.) so that the residual sharing range of fixed contract could be flexibly adjusted. Of course, this kind of liability exemption should pay the costs, which is a sort of compensation mechanism against the risks investor bears (for instance, the investment may not be able to be recouped.) According to the implicit contract theory, Eq. (2) and (3) can respectively be rewritten as $\pi_f = f + (1-r)(\pi - f - g) - I$ and $\pi_g = g + r(\pi - f - g) + I$, here I is the insurance expenses. That is to say, when $I > 0$ under the unfavorable natural conditions (a remarkably fluctuant ε), the military firm will pay additional insurance expense besides the quota for the investor, which is an opportunity cost for lowering the loan k when the failure of R&D project leads to a capital chain rupture. In the capital market, the diversification of insurance expenses could effectively reduce the systemic risk of portfolio.

5.4 Enlarging the capital market for defense industry, improving the mechanism of diversification of the main investors on defense R&D. According to the investigation and analysis of authoritative research institutions around the world, the R&D investment in China belongs to a below-average level on the overall size. In terms of the investment structure, the own input of firm is low and the market is still in its infancy, while the central finance lacks of a stable growth mechanism. In the field of defense science and technology, the problems that the aggregate investment is insufficient and the capital structural is imbalanced are more serious. The significance of introducing private capital is not only to solve the capital problem, but more to introduce the market-oriented operation mechanism. By using of the capital market, the military firm can broaden the financing channels, optimize the capital structure, reduce the system risk of the R&D. At the same time, the capital market can also provide the military firm with a leverage for merger and acquisition, helping it to carry out the horizontal integration. In 2007, the instructions for the non-public sectors of the economy participating in the construction of science and technology industry of national defense has clearly pointed out that, encouraging all kinds of social capital to enter into the military firms through acquisitions, asset replacement, joint venture etc., promote quality resources concentration, thus promoting the concentration of quality resources. Therefore, if we can make full use of the defense policies of science and technology development, increase and optimize the scale and structure of R&D investment relying on the capital market actively, a stable dependence between the two sides of investment could be established, and the zeal and consciousness for innovation of military firm could also be aroused, all of which could contribute to build a long-standing mechanism for a benign development of defense R&D. Technically, an investment boundary should be reasonably divided: The R&D project with core technology must be invested by the competent department of defense because of its high customization.

While those projects with a low customization, could be stripped out and handed to the third investor so as to greatly reduce the governance cost of the investor.

5.5 Broadening the technological boundary of defense R&D, establishing the defense innovation system based on a military-civilian sharing and integration. To achieve a military-civilian integration and to place the defense R&D upon the whole national strategy of both economy and science and technology, is a common policy choosing among the main developed countries in the world. Over the years, the science and technology industry of national defense of China has gathered powerful R&D capacities, and massively accumulated scientific and technological achievements which can be transferred into civilian use. On the other hand, the realm of civilian scientific research has possessed a strong foundation, and the strengths of many civil technologies have exceeded that of the traditional military realms. However, owing to the overall pattern of a military-civilian segmentation that cannot be fundamentally broken through, it is difficult for the civilian scientific research and industrial fields to radiate and permeate technologically into the military fields. What we should do at the present focused on: (1) effectively integrating the R&D projects between military and civilian, making full use of the resources of national scientific research, avoiding the regional segmentation and redundant construction; (2) strengthening the intervention and support of the key technology in defense R&D, choosing few major strategic products as a breakthrough, promoting the integration and innovation of major technological achievements, driving the rise and development of the high-tech defense industry; (3) actively carrying out the government purchasing policies, effectively reducing the preliminary market risks of high-tech products, creating a predictable market for the defense R&D.

5.6 Strengthening the supervision on the defense R&D, deepening the flexible management system of military firm. The variable λ has two sides. From the perspective of a large-scale cooperation for the defense R&D, the military firm must be provided with considerable freedoms to realize an independent innovation.

Nonetheless, a bigger λ is easily inclined to account manipulation and investment erosion. The lower is the disobeying ability of military firm, the greater is the power authorized by the contract. The key issue lies in an information asymmetry. Given a moderate informational cost, the investor could screen the technical qualification θ and supervise the non-productive rent-seeking, thus giving rise to a Pareto improvement. The 17th CPC National Congress has put forth a purpose of changing the mode of fighting capacity generation, required that the development of defense R&D should aim at high-end orientation of technology, diversification of varieties, integration of performance, rapidness of logistical support, etc. Therefore, as for the military firm, the traditional manufacturing industry based on mechanization, standardization, large-scale and replication has no longer adapted itself to the changes in the new situation, and has to adopt the flexible and elastic management mechanism on the aspects such as R&D project management, production management, financing management and etc., in order that the management innovation be a strong adhesive for both technology innovation and investment appreciation.

Notes

- [1] In the model of Zhang (1993), the technical efficiency parameter θ and decision freedom coefficient λ together with ω and k , are all the important variables for measuring π . Considering that this article is mainly to discuss the incentive effects for the different division rate r on ω , as well as the relation between r and k . So the function can be simplified as the two-dimensional variable form only including ω and k . Besides, the traditional production function $Y=Y(K,L)$ only analyzes two input factors $K(k)$ and $L(\omega)$, this article will follow this paradigm.
- [2] Holmstrom & Milgrom (1987) gives the conditions making a linear contract turn to an optimal one. Besides of assuming an absolute risk aversion ρ , they have thought meanwhile about a dynamic model selecting an effect variable ω in a continuous time.

[3] We assume the client is a rational investor who has a promising strategic investment plan, which is reasonably considered as an assumption with a good degree of fitting.

[4] Simply, we assume that in the range of relevant effort equilibrium, ω is strictly positive. For the analysis of $\omega \leq 0$, someone can refer to Jean Tirole (2004).

[5] Previously, we have analyzed $\frac{\partial \omega}{\partial r} < 0$,

and thus Eq. (1) can be also described as $\pi = \pi(\omega(r), k, \varepsilon)$.

[6] On account of the technical parameter θ of defense R&D (discussed in the fourth part of this article), the relation of the three variables

is: $\frac{\partial \omega}{\partial \theta} < 0$, $\frac{\partial \tau}{\partial \theta} > 0$ (for $\frac{\partial \psi(\omega)}{\partial \theta} > 0$), which can

be referred to the definition on the optimal regulation scheme by Jean Tirole (2004).

[7] Certainly, this relates essentially to the issues of enforcing and exiting towards the contract, which will be specially analyzed later. Telser (1980) regards that why the enforcing of contract can be a problem is mainly due to a counter-measuring behavior for a certain (or some) signing parties under the condition of a great supervising cost and asymmetric information, thus inevitably giving rise to a cheating or a breaching. At this point, the best punitive measure for the other party of contract is to suspend the contract relationship, that is, to exit. Of course, there also exists a possibility of existence for the seller. The related classic literatures include Coase (1937), Cheung (1969), Williamson (1985), Kornai (1993) etc.

[8] The decision-making freedom of defense R&D λ , refers to an authority on determining what and how to research and development restrained by the resources such as technical strength, investment amount, defense policy, etc. Here, $\lambda \in [0, 1]$.

[9] Including increasing the on-the-job consumptions for the interior personnel in the military firm, thus inflating the non-productive cost; or once the R&D project is in the red, the profit will be misrepresented; or invest for the non-R&D project.

The above will be discussed in the fourth part, or one might as well refer to Zhang (1995). In addition, the profound analysis about the issues such as the richness of behavior space and the forms of the contract, can be seen in Holmstrom (1987).

[10] Actually, among the related documents about the agency problem, the variables θ and ω are always used as describing the adverse selection and moral hazard, and we assume ordinarily that they are one-dimensional. The further discussion can be referred to Tirole (2004).

[11] The contractual relationship (whether it's an investment contract or an agency contract) discussed here is implicit for that there exist some unobserved variables among them, such as the effort degree of military firm, the emphasis degree of investment efficiency etc. All these variables cannot be written into an explicit contract because of their un-recognition. The related documents about implicit contract include Bailly (1974), Gordon (1974), Azariadis (1975) etc.

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PUBLIC-PRIVATE PARTNERSHIPS IN DEFENSE PROJECT: EXPERIENCE AND REFERENCE

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***Abstract:** Public-Private Partnerships (PPPs) are gaining popularity in defense since 1990s. Practice of defense PPPs in many countries have resulted encouraging outcomes, including releasing budget constraints, saving capitals and mitigating project risks. The PLA is building a modern logistics system and integrating the development of military and civilian sectors to improve supporting efficiency and effectiveness. Defense PPPs can be incorporated into this reform and serve as a spur.*

***Keywords:** PPPs, private sector, defense project*

1. INTRODUCTION

Although public and private sectors has a long history of providing public services and goods in wide ranges, the cooperation between the two in defense areas gains popularity only in the recent one or two decades. Since it is initially introduced into defense area in UK in 1990s during the campaign of New Public Management, Public-Private Partnerships (PPPs) in defense, due to its distinct advantage in reallocating risks and promoting project performance, has gained great recognition, and from then on it has been put into the practices of defense procurement in main developed countries, such as UK, Australia, US and Singapore. This paper tries to trace the path of PPPs evolution and explain what Public-Private Partnerships (PPPs) is and why PPPs becomes so popular in defense procurement?

According to OECD definition (2008, p.17.), PPP is “an agreement between government and one or more private partners (which include the operators and finances) according to which the private partner provide the service in such a way that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partnership”.

Generally PPPs are “situated between traditional procurement and full privatization” (2008, p.21.). That is to say, PPPs is an alternative of traditional procurement to help defense departments to “get better and cheaper weapons faster, and to work more effectively” (UK MOD, 1999).

In the past, PPPs are most commonly noted in other public-utility constructions, especially those infrastructures projects, such as transportation sectors(i.e., bridges, roads, highways, railways and airports), water and waste managing utilities, and buildings concern public welfare(i.e., hospitals, parks, schools). After been introduced into these non-defense areas, public-use facilities amounting to approximately 887 billion US dollars have been successfully delivered by private contractors globally, as statistics show (AECOM, 2005). Since 1996, more than 63 defense PPPs deals have been innovative signed by UK, MOD, involving accommodation, training, equipment, infrastructure, and these contracts amount as high as 10.08 billion pounds [1].

There are two invisible hands pushing defense PPPs forward in UK and around the world. On one side, main countries need to put more into defense area to improve national security and maintain stable.

Public-private partnerships in defense project: experience and reference

After the “cold-war” especially in the “post-911” era, the world is undergoing tremendous changes and adjustments.

Global challenges are continually on the increase, and new security threats keep emerging. For one thing, struggles for strategic resources, strategic locations and strategic dominance have intensified.

For another, non-traditional security issues such as terrorism, environmental disasters, climate change, serious epidemics, transnational crime and pirates are becoming increasingly prominent¹.

In such a world with uncertainty, governments have a strong imperative to consistently promote its national by enlarging defense expenditure.

World annual defense expenditure reached 1,000 billion in 2006 for the first time after “cold-war”, and keeps amounting up.

On the other side, to constraint financial deficits, a huge amount of defense budget cannot always get approved by parliament.

Certain important projects if they are not critical important, would be commonly curtailed to some kind of degree.

2. MAIN CHARACTERISTICS OF PPPs

While PPPs provide a normal form for public departments and private sectors to cooperate on public-use projects and gain a growing popularity around the world, defense PPPs seem lag behind.

With no standard definition of PPPs, different countries, departments and stakeholders interpret PPPs in varying ways. In summarization, there are some key characteristics help us to distinguish PPPs from traditional procurement and privatization (or outsourcing).

2.1 Providing financial flexibility. In traditional defense procurements, many projects are canceled or delayed due to financial constraints and budget disciplines.

However, the flexibility provided by PPPs erodes the public budget constraints by allowing more and more defense construction and procurement to be undertaken through private financing. PPPs tools such as Private Finance Initiative (PFI) could be feasible only when “they can offer the potential to achieve greater value for money² than could be achieved under more traditional ways of doing business, while improving or sustaining front-line capability” (UK MOD, 2001).

As an alternative defense project financing options, PPPs work better only when those projects are large enough in scale and provide relatively stable revenues for private investors.

2.2 Optimizing project risks allocation. Besides saving capitals, there are more prominent characteristics in PPPs.

The PPPs mode emphasizes an optimal transfer of project risks to the party that best able to manage them with least cost, faster completion and improved quality.

There are different levels of risks in a defense project, and the private partners are proficient in dealing with market level risks but obviously noncompetitive in handling risks of state level.

Proper project risk-sharing is one of the pillars for successful PPPs mode, and there are diverse modes of PPPs for delivering services and goods.

By properly reallocating project risks and liberating the armed forces from non-core competence building, private contractors enable the armed forces to focus on mission-critical activities (or combat capabilities)[2].

“Through PPPs, the public sector seeks to bring together the expertise and resources of the public and private sectors to provide services to the public at the best value for money” (Singapore Ministry of Finance, 2009(b)).

2.3 Using quantitative measuring tools. To ensure efficiency and effectiveness of PPPs projects, some countries have developed quantitative measuring tools.

2 The optimum combination of whole-of-life costs and quality of the goods or service to meet the users’ requirement.

1 http://www.china.org.cn/government/central_government/2009-01/20/content_17155577.htm

In fact, the MOD, UK, has first developed an economic tool called the Public Sector Comparator (PSC) in order to better compare the value gained in the transfer of risk and determine whether traditional procurement or PPPs is the better choice. As the most prominent quantitative measuring tools, the public sector comparator (PSC) is widely used in UK, Australian and Singapore. In such an assessment, PSC would calculate the in-house implementation of the defense project as a benchmark, and then compare with the total cost completing the same project using a PPP mode. Besides, competitive bidding is also applied in some cases as a means to find the suitable private contractor [3].

2.4 Availability and usage based payments. There are basically two main kinds of application of PPPs, the Design-Build-Operate (or COGO) and Build-Own-Operate model (or COCO). The difference lies that in the COCO model the private sector retains the ownership, and the COGO model allows for public ownership while utilizing private financing. PPPs contract is a set of property exchange, in which the public sector impart the right of building, operating and managing of the projects to private sectors, while the private sectors contribute capital and management expertise to provide service or goods to defense departments[4]. As a typical defense PPPs contract could last as long as more than 20 years, to mitigate managing risks, defense departments and private sectors would set up a long term contracts, which detail that unless qualified service or goods are supplied, can private sector achieve payments.

3. PLA's ACHIEVEMENT IN COOPERATING WITH PRIVATE SECTORS

In a wide range of scopes, the PLA is still responsible for providing all the goods and services directly, and thus it has to processes all necessary resources. In a PLA traditional equipment or service procurement, the defense department has to take responsibilities for the whole risks and responsibility in the entire spectrum of acquisition activities.

Even if there are private partner, however, these private contractors are only partially involved into the project, and assume corresponding responsibility in limited cases.

The New Public Management (NPM), which emphasize on market orientation, has clearly exerted certain influence on the PLA.

To further improve operational effectiveness, the PLA has greatly improved its traditional procurements, partially switching from self-sufficiency to market supply.

In fact, the PLA has already selected a market oriented path for logistics reforming. In order to enhance its logistical support capabilities for diversified military tasks, the PLA is working on a multilateral approach to build a modern logistics system by speeding up the process of outsourcing services, managing its logistical support systems in a more scientific way.

In December 2007 the CMC promulgated the Outline for Building a Modern Logistics System, specifying the guidelines, principles, objectives and tasks for the development of modern logistics.

Aiming at enhancing the cost-effectiveness of logistical support, the PLA vigorously promotes outsourcing in logistical support method to build a modern logistics system.

To speed up this outsourcing process, the PLA outsources the commercial and housing services of combat units stationed in large- and medium-sized cities, general-purpose materials storage, capital construction, logistical equipment production and logistical technical services. Also, the PLA try to promote diversity in investors in defense-related enterprises. In 2010, the Ministry of Industry and Information Technology and the PLA's General Armaments Department jointly issued the Implementation Measures for the Licensing of Weaponry and Equipment Research and Production to further encourage different types of economic bodies to participate in the defense scientific research and production of weaponry and equipment. The 18th National Congress of CPP made it clear that the PLA will continue to follow a Chinese-style path that integrate the development of military and civilian sectors[5,6].

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Pushed forward by these driving factors, it would be reasonable to deduct that it is worthwhile to incorporate the PPPs mode into the procedure of building a modern logistics system. However, there are multiple obstacles needed to be overcome prior to the acceptance of PPPs. For example, as the defense department is obligated to provide public security, whether PPPs projects deliver value for money should not only rely on financial balance and revenue only, but more importantly, also on whether projects risks can be managed more effectively. The fact is few come into realization.

4. RECOMMENDATION ON PROMOTING PPPs IN PLA DEFENSE PROJECTS

The concept of civil –military integration is nothing new. UK defense PPPs continue to gain momentum since the first PPPs contract was signed in 1996, which is mainly about providing combating vehicles to MOD.

And since then different types of privatization have been introduced into China, such as outsourcing, contracting out and marketization. But in PLA, there are more tough works waiting to be done for the innovative uses of defense PPPs.

4.1. Overcome certain budget constraints. Traditional defense procurement style is fully funded, which requires a large portion of capital to be tied up early in a project's life cycle.

In the near future, it seems PLA will still not suffer from capital shortage, but with the costs of cut-edge technology and infrastructure keeps climbing, PPPs continually remains as an appealing financing approach apart from traditional modes of appropriating funds.

In an era with growing tight budget, defense department has to compete with other departments and projects fiercely to justify the value of every penny spent.

Confronted by the residual impact of the global financial crisis and other uncertainties, the tension between revenue and military expenditure in China's finances persists.

Thus, a tight fiscal constraint would necessitate the practice of PPPs to serve as a supplement of its military budget or help to remove its national debt “off-balance sheet”[7].

4.2. Continue to modernize concepts of logistics management. Admittedly, China remains slow in catching up with the development of PPPs in defense procurement due to a series of bureaucratic requirements, under-developed marketization and excessive oversight in private sectors. The adoption of PPPs is not only an efficient governance tool to release national debt containment, but also symbolize a concept transformation to modern logistics. In a principle-agent relationship, the PPPs mode has inevitably transformed the role of defense department from a manager of resources to manager of contracts, so the public sector has to develop a set of new management skills, particularly contract managing skills.

Whether defense procurement in China will embrace a PPPs contract depends on how the PLA define the relationships between defense department and private sectors. To further improve PPPs implementation in China's defense area, the PLA must pay more attention to market as invisible hands.

4.3. Develop quantitative measuring tools to evaluate risk transfer. It is common knowledge that PPPs process many different kinds of definition and is consisted by different forms, but in every PPPs contract, responsibility and levels of risk are synonymous.

The MOD, UK, would only approve projects that offer lower lifecycle cost, or the best value for money, in the acquisition cycle with PFI.

With its own unique fiscal system, operating system and defense priorities, however, the PLA would find it is difficult to decide whether to pursue a PPP mode in a certain defense project, because the quantitative measuring tools, like PSC, are “highly subjective and vulnerable to bias”, and “its complex financial models are also prone to error”.

That's to say, a change in the discount factor or the assessment of risks may reverse PPP's favor. Some defense projects cannot be commonly found in private sectors and are complex to define and practice.

As a result, a major concern of the PLA pursuing PPP mode is to develop its own quantitative measuring tools and to learn to identify, quantify and verify the value of risks have been transferred to private contractors.

4.4. Select proper defense areas and PPPs modes to make experiments. The spectrum of PPPs could be divided into three categories. The first and most prominent is known as Private Finance Initiatives (PFI), in which the public sector contracts to purchase goods and services in long run. This includes projects in which private sectors shoulder responsibilities for providing public services, like constructing and maintaining military assets.

The second category involves introducing the private sector partnership into state owned military industry enterprises using a strategic partner, usually with a minority stake. The third partnership arrangement is using private sector expertise and financial resources to exploit the commercial potential of military assets [8].

Modern Logistics System puts great effort on raising cost-effectiveness. Following this principle, it continues to push forward the process of outsourcing daily maintenance services, and takes steps to outsource other services, such as general-purpose materials storage and integrated civilian-military equipment maintenance.

After entered into the new century, the PLA has taken multilateral approaches to building a Modern Logistics System.

It seems that there are a wide range of areas in defense procurement that are more suitable to adapt a PPPs mode by contracting out to private sectors of expertise, like military accommodation, transportation, medical treatment, training facilities, equipment servicing and other technologically sophisticated equipment projects.

Especially, PPPs should be capable of providing direct supports for front-line operations, including military operations other than war (MOOTW).

5. CONCLUSIONS & ACKNOWLEDGMENT

Despite of the weakness and difficulty have been pointed out, the PPPs mode which adheres to the principle of building Modern Logistics System, would still serve as a spur to PLA modernization.

However, in an unpredictable and fast-changing world, misunderstanding and ambiguous objective in defense PPPs implementation may yield costly economic and social consequence.

The PLA has to improve its policy guidance and legislation to pave the way for more defense PPPs especially by allowing more private industries to compete equally with state-owned war industries and acquiring more skills of contract management.

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THE STUDY ON CHINESE DEFENSE SCIENCE AND TECHNOLOGY INDUSTRY MANAGEMENT INNOVATION IN THE POLICY OF CIVIL- MILITARY INTEGRATION

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Abstract: *This paper analyzes the difficulties of Chinese defense science and technology industry management, and then put forward to some methods to achieve management innovation in the policy civil-military integration. The methods can be summarized as follows: to build innovative management system, to coordinate the management operation mechanism and to improve relevant laws and regulations.*

Keywords: *Civil-military integration; Defense science and technology; Management; Innovation*

1. INTRODUCTION

Since the implementation of the civil-military integration strategy in Chinese defense science and technology industry, brilliant achievements have been made—defense science and technology resources are effectively utilized and the viability of enterprises are greatly enhanced;

The integration provided enterprises better material basis and effectively promoted them to improve the R&D level of military products; the integration also led to the deepening of enterprise reform, and accumulated useful experience for the development of defense science and technology industry under market economy conditions.

However, at the same time there are still many problems about Chinese defense science and technology industry management.

Therefore, how to innovate the management of defense science and technology industry still has a positive meaning.

2. THE TEXT OF THE PAPER

2.1 To improve relevant laws and regulations. Sound regulatory system is the premise of defense industry integrating into the development of social economy.

For integrating defense science and technology industry management into the social economy development all-around, the major developed countries put attention to legislation to make defense economy and social economy development in harmony.

For example, in the United States, there are the Defense Production Act, the national defense patent law, researching and ordering systems involving weapons and equipment, defense technology and weapons and equipment management system and so on; to promote the integration of national defense construction and social economy development, the United States also introduced a variety of rules, regulations or plans to between the two.

Since 1990, in order to promote the integration of defense scientific research and production, the United States have in succession introduced technology transfer program,

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Advanced Concept Technology Demonstration program, dual-use science and technology program, Department of Defense manufacturing technology program, independent research and development program, North American technology and industrial base organization plan, technology transfer initiatives, Small Business Innovation Research program and so on.

Market economy is legal economy, and there is no aspect of civil-military integration not needing the adjustment of law category.

Therefore, the state should improve relevant laws and regulations of national defense science and technology industry comprehensive civil-military integration as soon as possible, providing law foundation for defense science and technology industry management.

Specifically, the state should do the following work:

Establish market competition regulations of weaponry research and production.

In U.S., the legislation in this regard has been very mature, as in 1984, "Competition Law of signing the contract" states: "Defense department (acquisition of assets and services) should adopt open competition procedures."

In 2003 its "Defense industrial basic transformation road map" stressed the need to change the situation of main contractor controlling defense market, and to guide and encourage SMEs who master innovative technologies into defense sector, thus forming the new defense market structure of different size and many suppliers.

"2009 Weapon Systems Acquisition Reform Act" stipulates that there must be two or more competitors provide competitive prototype in weapon system technology development phase.

"Defense Production Act" requirement: "The president should give preferential to small businesses (including subcontractors and suppliers) small businesses acting as contractors or subcontractors in all projects at all levels should obtain opportunities as many as possible, in order to maintenance and strengthen national industrial base and technological base.

" In view of this, our country should reform the existing military procurement regulations, work out "national Defense procurement Law" or the " PRC military procurement law ", as soon as possible under the guidance of the spirit of the Constitution. Open the military market gradually.

Formulate standardized systematic laws and regulations of civil-military integration, accelerate military standardization reform and progressively implement standard for dual-use.

In order to promote the integrity of military standards and civilian standards, in 1994 "Federal Acquisition streamlining bill " made a major adjustment on military technical standards, implemented the strategy of using more civilian specifications and standards.

America advocates the use of civil standards and business practices in the equipment acquisition process. In 1994 the United States Secretary of Defense released the theme of "norms and standards - new method of doing things" memo, allowing contractors to determine their own quality systems.

China should accelerate the military standardization reform, and gradually achieve the integral standard of military and civilian.

We should accelerate the establishment of the complementary regulations and standards system of national, military and industry.

Any civil standards which can meet the military requirements should be used directly, rather than to develop a separate military standards. Under the premise of ensuring the performance of weaponry, we should positive use civilian standards in line with the requirements of military. Draft "Military Standardization Management Regulations". The relevant departments can listen to the suggestion of defense industry authorities departments and military equipment departments, in order to ensure civilian standards to meet military needs as far as possible.

Accelerate the establishment of national defense intellectual property protection laws and regulations. "Bayh-Dole Act" confirmed the principle of "Who developed, who owns", which greatly facilitates the integrity of military and civilian.

It involved defense intellectual property rights laws and regulations including "Federal Acquisition Regulation", "Federal Technology Transfer Act," "Arms Export Control Act," "Export Administration Act," etc.

In addition, Defense Department and defense-related sectors (such as the Department of Energy, NASA) had also developed a number of intellectual property management regulations, such as: "Federal Acquisition Regulation Defense Supplemental Rules", "Federal Acquisition Regulation DOE Supplemental Rules", "Federal Acquisition Regulation NASA Supplemental Rules", "Army of intellectual property management regulations" and so on.

The regulations can encourage private participation in defense research and greatly reduce the costs.

So, we should actively study weaponry intellectual property right definition and management problems, establish and improve protection and management regulations, strengthen the protection consciousness of intellectual property rights, pay attention to the use of legal means to promote and protect defense technology to enter the market, allow military intellectual property ownership and right of use to appropriately separate.

National defense science and technology departments should give full play to role of patent laws and regulations system, pay attention to the use of legal means to promote and protect national defense science and technology transferring into practical productive forces.

Establish "national defense scientific research and production law" and specific criteria, specifications matching "weapons and equipment research and production license implementation methods", such as weapon equipment development contract, manufacturing contract, quality supervision and management procedures; according to national defense science and technology industry reality, establish and improve regulation system of national defense science and technology industry achievements and technical transferring.

For example, study and formulate "national defense science and technology industry achievements and technical transferring regulation" and relevant laws and regulations on "use high technology to promote national defense science and technology industry basic capacity".

The main contents include national defense science and technology industry achievements and technical transferring methods, sharing of authority and benefit, legal responsibility of encrypting and decrypting and so on, orderly adjust and specify relationships of different subjects in process of national defense science and technology industry achievements and technical transferring, to ensure that national defense science and technology industry achievements and technology can be fully used, and obtain the maximum benefit. Establish Defense contracts laws and regulations as soon as possible. The U.S. government insisted that contracts for defense economic activity are their only choice.

Contracts have an important position in the civil-military integration, which formed the characteristics of U.S. defense industry system.

The U.S. Congress passed "1984 signing contract competition law" to promote civil-military integration and defense acquisition reform. U.S. governments manage the units participating defense research by contracts. "Federal Acquisition Regulation" and Defense Ministry's "Supplemental Rules" made detailed provisions for U.S. contract management of military and civilian integration. Compared to administrative, military force and free trade method, Contract management has a great advantage. As the microscopic forms of development of military and civilian integration, defense contract is not only in full compliance with the inherent requirements of the development of military and civilian integration, but also can effectively realize military-civil integration. Therefore, China should draw "PRC Defense Contract Law" and develop "defense research and production method" to regulate weapons and equipment research contracts, production contracts, quality supervision and management procedures.

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Legislation of the management of defense science and technology industry is an organic and unified entirety of legislating, changing, and abolishing. We should not only pay attention to the creation from scratch, but also cleaning up the existing system, amending and abolishing current laws and regulations not adapt to civil-military integration. Such as U.S. legislative bodies and administrative departments pay attention to repeal, amend outdated laws and regulations and develop new acquisition timely in order to promote the reform, when facing new situations. In 1991 U.S. Defense Department has set up a special group to comprehensive clean-up and review of the relevant laws. The provisions relating to weapons and equipment and ordering system in "National Defense Law of the People's Republic of China" should be refined; Those laws and regulations unable to adapt to the new situation and new tasks of civil-military integration, be overall feasible and individual terms are not applicable must be necessary to revise and perfect. For example, the contents of Military supplies are not established in "Contract Law" on the 15 contracts. There are no principled provisions of how contract is drafted on national defense scientific research military and military orders and other aspects, thus we lack of sufficient legal basis to formulate relevant laws and regulations. So we suggest including relevant military supplies into military contracts normative contract directory and establishing principled provisions on the related problems in "Contract law". Regulations which cannot be applied to current needs in general, even conflict with other laws, and cannot solve problems rely on modifying and improving individual provisions must be abolished.

2.2 To build the innovative defense industry management system. Integrating national defense and army modernization construction into the social economy development is involved into the national strategy, which covers various sectors of the military and civil, and all of the developed countries have the highest coordination body. The National Security Council Entity is the highest coordinating body in America.

The Commission is a permanent body, with full-time staffs. Besides policy-making functions, it has the ability to implement the decision-making. In addition to top-level coordinating body, there are also special coordinating body to promote integration of the field of defense technology and production, such as the Defense Technology Transition Committee established in 1993. Its chairman is served by the secretary of the Defense Advanced Research Projects Agency (DARPA) and the members are from the Army, Navy, Air Force, the Commerce Department, the Department of Energy, Department of Transportation, National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF) and so on. According to our national situation, civil-military integration is a kind of reflection of and national behavior and will, so it should be promoted through national policy and military departments coordinately. We should begin with high-level decision-making, comprehensive coordination and policy implementation, according to government and military departments' functions, to establish scientific and reasonable operation mode. On the division of responsibilities, it should be that military department claim demands, high-level decision-making body coordinate relationships among departments, government management sector monitor implementation of policies. Civil-military integration involved adjusting interests function between departments, which needs different departments to work together under the leadership of Party Central Committee and State Council. That how to unify the different thoughts of various departments, establish effective macro control and strategic synergy mechanism is an urgent the problem which need to address now. The key is a central leader who can manage military and civil both establish authoritative high-level coordination mechanism. Play and strengthen his decision making, coordination and supervision function of strategic issues, such as national significant science and technology project, national defense science and technology major planning and significant civil-military integration industry base, and improve decision procedures and coordination mechanism according to the present government and military system situation.

We should establish high-level decision-making mechanism coordinate civil-military integration, improve national economy macro-management system, for example, we can set up an office responsible for the daily coordination work under State Council. We should also clear defense integrated department and its corresponding responsibilities, strengthen national defense integrated work, improve national defense construction management system, for example, clearing National Development and Reform Commission's defense functions of regulating national economic mobilization and economic and social development, taking considering the overall balance of national defense construction as one of the basic duties and daily work. Strengthen central committee functions of State and Central Military Commission, which has the power to enact major principles and policies of national defense construction, harmonious development and rational resources allocation of national industry and science and technology, decide, coordinate and supervise implementation of major dual-purpose project and mutual transferring of technology. Relevant government departments, national defense science and technology industry comprehensive management departments, science and technology education departments, military equipment management departments, all arms constitute it. We can set up an office assuming coordinating the daily work and Expert Advisory Committee responsible for the major dual-purpose project assessment and providing advice for major decision-making (It consists of well-known experts of military and civil). According to the long-term development and reality demand, relevant military departments (equipment department), can take the relationship between short-term and long-term and need and possibility into consideration, propose scientific and reasonable demands of military construction and equipment development. Finally the demands are collected to a department of Central Military Commission (such as the assembly), and then be evaluated. Set up communication and interaction mechanism among government departments and between military and civilian.

Establish fixed communication channel and working procedure through means of the joint meeting, offices and regular communication.

2.3 To coordinate management operation mechanism. The first thing to do is to improve competition mechanism. Above all, expand the military market scope. With the rapid development of civilian technology, many countries realized that the full use of the achievements and resources of civilian areas to serve national defense construction is an important way to improve the efficiency of resource, and therefore they take various measures to actively support and encourage the civilian enterprises to participate in military weapons equipment research and production. Support civil SMEs to develop products for the military, has become the guidelines of the U.S. military. Weapons and Equipment General Administration of French Defense Department make it clear that they should encourage SMEs to participate in the competition of weapons and equipment procurement, especially in the sub-systems and equipment levels. To ensure that SMEs access to military research projects, Weapons and Equipment General Administration set aside 10% of the acquisition plan as the competitive project of SMEs. Therefore, government departments should unify the management of military products market access and authentication. Those units who engaged in weapons and equipment research and production grant corresponding license in accordance with the provisions, and those private enterprise who comply with the conditions can be absorbed in; military equipment order department should coordinate with government departments effectively, select the best equipment production units in designated market circle to promote the market competition order. The second is to accelerate investment system reform of national defense science and technology industry. According to "State Council's approval on deepen national defense science and technology industry investment system reform", formulate supporting policies and measures. Formulate and implement specific methods and measures of civilian units into weapons and equipment research and production areas.

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Draw up "social investment guidance catalogue" to introduce social capital, advance diversity of investment subject. Actively introduce social capital, advance diversity of investment main body.

To improve the incentive mechanism is another important thing. Give full play of the government's guiding role in investment. Encourage and support civil-military integration through direct financial investment, preferential tax and other financial investment ways. In the process of absorbing and introducing civilian technology into military product development and production, set up special funds to promote national defense basic ability. Encourage to absorb and introduce high civilian technology ability. Implement relevant taxation policies, encourage and support enterprises to develop dual-use new product, new technology and new technology. Increase incentive policies, such as the pre-tax deduction of enterprise investment in research and development, implement preferential tax policies to promote the development of hi-tech enterprises. Offer necessary tax supporting policies to the purchase of advanced scientific research instruments and equipment. Increase foreign exchange and finance supporting to overseas research and development institutions of enterprises, provide convenient and quality services for foreign investment. Implement relevant financial policies. Establish and improve the investment mechanism, set up multi level capital market system. Create a more relaxed financial and foreign exchange environment for the high-tech venture investment enterprises operate capital among countries. Take positive steps to explore investment ways of government funds for guidance, policy finance and commercial finance capital for main body, promote more capital into the venture capital market.

To improve the evaluation mechanism is also necessary. Establish communication channels and bodies for information services and evaluation, assessment, certification of civilian technology potential military value and dual-use technology; establish evaluation system reflecting coordinated development of national defense and the economy.

Establish information communication channels of military research and production and construction. Promote network and dynamic change directional development of military market supervision mode, shorten the information chain. Establish military and civilian enterprises information communication platform, form information open communication channels.

3. CONCLUSIONS

Civil-military integration is the trend. In the context, how to improve the management of Chinese defense science and technology industry must be a very worthwhile topic of concern. We should learn from the experiences and practices of developed countries, to build innovative management system, to coordinate the management operation mechanism and to improve relevant laws and regulations. Of course, in addition to the above practices, there are other ways that should be studied. They will be the object of further research for the authors.

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RESEARCH ON RETIREMENT TENDENCY OF PROFESSIONAL TECHNIQUE CADRES IN THE ARMED POLICE FORCE

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***Abstract:** Why highly educated and high-quality professional technical cadres that the troops needed the most ask to retire from service? On this issue, the paper discusses the retirement tendency of professional technical cadres based on the three-dimensional model of the job control. In the survey of 216 professional technical cadres, the data show that the job control has a significant negative influence on retirement tendency, which can significantly increase the model's explaining ability to retirement tendency. Finally, combining with the analysis results, it puts forward the suggestions to reduce the retirement tendency of professional technical cadres.*

***Keywords:** Armed Police Forces; Professional technical cadres; Job control; Retirement tendency*

1. INTRODUCTION

As the main carrier of modern knowledge of science and technology, professional technical cadres of Armed Police Force plays a more and more important role in terms of advancing forces modernization construction. However, the recent situation of the personnel construction of the Armed Police Force personnel is not optimistic. Especially it's difficult to attract and retain high quality professional technical cadres. Some highly educated, high-quality talents also have little interest to work in the troops. Part of the professional technical cadres can't set their minds to work and ask to retire from active service. The presence of these problems has influences on the stability of the troops and restricts the development of forces. Therefore, it has a positive theoretical and practical significance to focus on the professional technical cadres' idea that stay in the troops or not, analyzes the causes of their retirement tendency and does a good job of attracting and retaining high quality professional technical cadres.

Retired tendency means that due to the influence of various factors, cadres in the troops generate the wills or ideas of leaving troops and discharging from active service voluntarily.

In this paper, retired tendency is mainly refers to leaving forces spontaneously, rather than passive forced. The dependent variable adopted by the writer is the cadre's retired tendency, not the actual behavior of transferring to civilian work. As the important factors of retirement, job control is gradually attracts the attention of scholars. Averill summed up three kinds of different control: cognitive control and behavior control[1], decision-making control.

The author combines the job control with Averill's three-dimensions of job control, and makes a general definition, that is, from the experience, ability and targets, the group members' determination and the influences of the feeling, content, environment and development the job. In other words, it is the individual's feeling that if the job is in their control. Another main train of thought is to explain the retired phenomenon from the angle of the compensation.

Research on retirement tendency of professional technique cadres in the armed police force

American psychologist, Herber G•Heneman, divides the compensation into four dimensions: compensation level, compensation structure, compensation system and compensation form[2]. Combined the reality of the troops and the demand of research, the author divide the compensation into two dimensions: the compensation level and compensation structure which combine the compensation level and compensation form into compensation level, and combine the compensation system and compensation structure into compensation structure.

On the basis of the discussion and interviews, the author make three assumptions of the relations among job control, compensation incentive and retirement tendency:

Hypothesis 1: Job control and retirement tendency of specialized technical cadres in CAPF have negative correlation.

Hypothesis 2: Compensation incentive and retirement tendency of specialized technical cadres in CAPF have negative correlation.

Hypothesis 3: There is interaction between job control and compensation incentive. That is, the higher the compensation incentive of professional technical cadres, the weaker the influence of job control to the retirement tendency. And the lower the compensation incentive of professional technical cadres, the stronger the influence of job control to the retirement tendency.

2. DATA SOURCES AND SCALE DESIGN

2.1 Data sources. In June and July, 2012, author carried on a questionnaire survey to the faculty from three Armed Police colleges, doctors from two hospitals and professional technical cadres who take a refresher course in the Engineering University of CAPF. Send 230 questionnaires in total and recycles 218, of which 216 was valid. The valid recovery rate of the questionnaire was 93.9%. In the professional technical cadres, male occupied 67.8%, female occupied 32.2%; The average age was 33.94 years; In terms of education, the degree of doctor, master, bachelor, junior college degree of proportion were 9.2%, 62.0%, 27.8% and 10% respectively;

The average length was 12.87; In terms of the title, the principal, subtropical, intermediate, junior were 5.6%, 16.2%, 37.0% and 41.2% respectively; Professional technology level on level 4 to 7 occupies 16.1%, level 8 to 11 occupies 41.5%, below level 12 occupies 42.4%.

2.2 Scale design.

(1) Control variable. Some scholars think that turnover intention is affected by individual demography variables[3]. Therefore, the author considered in the analysis of the effects of demographic variables on the tendency. These variables including gender, age, military, education, job title, professional technology level, etc. This questionnaire consists of 6 questions. The average score stands for the professional technical cadres personal attributes.

(2) Job control scale. It totally designs cognitive control, behavior control, decision control, etc. Three secondary indexes, consists of five tertiary indicators, 17 survey questions. 3 of them are from the scale made by Yperen and Hagedoorn in 2003[4], 1 form the control scale compiled by Thomas and gans in 1995[5], 3 of them are from the scale made by Ma Jianhong and Zhang Tingwen[6]. The remaining 10 questions are designed by the author according to the characteristics of specialized technical cadres in CAPF. Through four times of exploratory factor analysis, the author deletes 3 questions, keep 14 questions. Qualified extracted the 3 common factors, measuring 2 common factors contains questions the same as the previously compiled by the author. Respondents evaluate these subjects in the Likert four-point scale, dragon Bach coefficient of the scale is 0.881 a. I scored an average by a scale on behalf of the professional technical cadres' job control, the higher the score suggests that the professional technical cadres have more job control.

(3) Compensation incentive scale. Totally set two secondary indexes: pay level and pay structure, consists of three level indicators, 15 survey questions. Among them, there are 4 questions using Pan Yunjuan (2008) compiled by the compensation satisfaction scale[7], 11 problem is based on the characteristics of armed police army specialized technical cadres, the topic of design.

The author through the exploratory factor analysis, four times deleted 3 problem respectively, retain 12 questions. Limit extraction for two common factors, measuring two common factors contains questions the same as the previously compiled by the author. Respondents at four o'clock in the likert scale to evaluate these subjects, the scale of g dragon Bach coefficient of 0.898 a. Scale score on behalf of the professional technical cadres compensation incentive, the higher the score, suggests that the greater of incentive pay to professional technical cadres.

The higher the score is, professional technical cadres have stronger retirement.

3. RESEARCH RESULTS

Through PASW software for job control scale, scale and retired compensation motivation tendency scale has carried on the descriptive statistical analysis.

Table 1 reports the mean, standard deviation and coefficient of correlation of the variables in this study. We can found that job control and retirement tendency of professional technical cadres have negative correlation (The correlation coefficient=-0.508, Significance level<0.01).

Table 1. Study of variables' mean, standard deviation and coefficient of correlation

variable	mean	Standard deviation	Cognitive control	Behavior control	Decision control	Compensation level	Compensation structure	Job control	Compensation incentive	Retirement tendency
Cognitive control	2.81	.5101	1	—	—	—	—	—	—	—
Behavior control	2.35	.6233	.545**	1	—	—	—	—	—	—
Decision control	1.97	.5671	.522**	.536**	1	—	—	—	—	—
Compensation level	2.40	.5365	.427**	.406**	.409**	1	—	—	—	—
Compensation structure	2.34	.5325	.574**	.607**	.555**	.707**	1	—	—	—
Job control	2.38	.4712	.811**	.853**	.826**	.497**	.698**	1	—	—
Compensation incentive	2.37	.4937	.542**	.548**	.521**	.924**	.923**	.667**	1	—*
Retirement tendency	2.51	.7292	-.445**	-.453**	-.369**	-.523**	-.577**	-.508**	-.595**	1

** . In the .01 level significantly correlated (double side).

(4) Retirement tendency scale. The author uses 4 questions to measure the extent of professional technical cadres' will to leave troops. 3 questions are a reference turnover intention scale by Griffeth and Hom (1988)[8] and Mobley's (1979)[9]. These three questions are "do you often consider of switching to the local?", "if I can find a good unit, do you want to transfer to the local earlier?" "Are you considering of switching to the local for a year or two?" In addition, the author adds a question "If possible, you will always work in the troops? (Reverse score)". This paper chooses a four-point scale and let the respondents evaluate these subjects at four-point likert scale, The scale of g dragon Bach coefficient of 0.810 a. The average score of the scale is on behalf of the professional technical cadres' retirement tendency.

Table 2. Study of variables' mean, standard deviation and coefficient of correlation

Project	model 1	model 2	model 3	model 4
Control variables	-.136*	-.086*	-.048*	-.039*
Cognitive control	-.250*	—	—	—
Behavior control	-.203*	—	—	—
Decision-making control	-.149*	—	—	—
Compensation level	—	-.231**	—	—
Compensation structures	—	-.414**	—	—
Job control	—	—	-.232**	—
Compensation incentive	—	—	-.459**	—
Job control × Compensation incentive	—	—	—	-.157**
R2	.267	.360	.387	.202
ΔR2	.240	.344	.350	.184
F	20.062	23.588	28.243	12.238

a. dependent variable: retirement tendency

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Compensation incentive with professional technical cadres retired compensation motivation tend to be negative correlation (The correlation coefficient=0.595, < 0.01). Respectively, it supports the front of the author puts forward the assumption of 1 and 2 hypothesis.

Considering the correlation coefficient can't rule out the effects of other variables, the author will adopt the method of regression analysis, further to test hypothesis [10]. As shown in table 2, the author respectively in model 1 and model 2 to join job control and salary incentive factors variables; In model 3, the author joined the job control and compensation at the same time the two main variables. Analysis results show that the cognitive control and behavior control and decision-making control has a significant negative influence on retirement tendency, it can significantly increase model for retirement tend to explain ability (explained variance percentage change in value = 0.267, significant level of < 0.05). Among them, the cognitive control to retirement tend to the influence of the most significant (regression coefficient = 0.250, significant level < 0.05). Compensation levels and compensation structure has a significant negative influence on retirement tendency, it can significantly increase model for retirement tend to explain ability (explained variance percentage change in value = 0.360, significant level of < 0.01). Among them, the compensation structure on retirement tend to the influence of the most significant (regression coefficient = 0.414, significant level < 0.01). When the two variables were added to the regression model, which has a significant negative influence on retirement tendency still (= 0.232 for job control: regression coefficient and significance level ≤ 0.01 ; the salary incentive: regression coefficient 0.459, significant level of < 0.01)), can significantly increase model for retirement tend to explain ability (explained variance percentage change in value = 0.387, significant level of < 0.01). The above analysis results further support the hypothesis 2 and hypothesis 1.

Here the author according to the Baron and Kenny (1986) [11] on the inspection regulation effect of the standard process to test hypothesis 3 (model 4) in table 2.

Regression analysis results show that the interaction item can significantly predict the professional and technical cadres retirement tendency (= 0.157 regression coefficient and significance level < 0.01), and brings the model explanation ability significantly increased, the percentage of variance explained the change of value = 0.202, the significance level < 0.01).

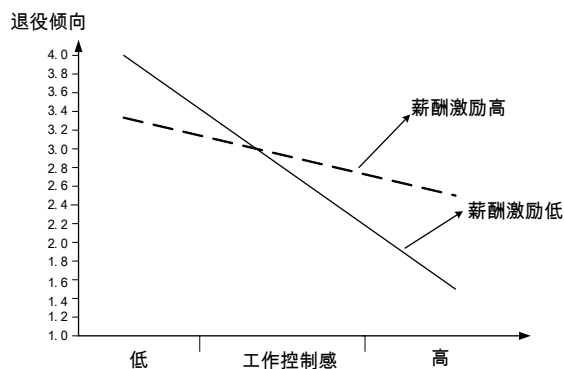


Figure 1 job control and compensation incentive

In order to further test whether adjustment effect in the direction of the hypothesis is consistent with earlier in this article, the author respectively to calculate the salary incentive score is higher (+1 standard deviation) and lower (-1 standard deviation), job control impact retirement tendency of regression equation (as shown in figure 1). As can be seen from the figure 1, when the professional and technical cadres salary incentive is weak, job control for retirement tendency to have significant negative impact; And when the professional and technical cadres salary incentive is stronger, job control for retirement tend to become less significant. To sum up, the assumption three gets supported that there is interaction between job control and salary incentive.

4. ANALYSIS AND DISCUSSION

In this paper, the research results will help answer the important issue of "how to prevent the high-quality professional technical cadres' retirement effectively". Experience judgment and the empirical analysis show that the job control is one of the important factors affect professional technical cadres' retirement tendency.

In order to reduce the retirement tendency of high-quality professional technical cadres that the troops need, relevant department must devote themselves to cultivate the honorable reputation and responsibility of professional technical cadres, promote their job control, further improve their Compensation treatment and try every means to maneuver their initiative and enthusiasm.

Pay attention to improve the professional technical cadres' job control. Relative to the civil department, military officers, including professional technical cadres have lower job control. Therefore, to improve professional technical cadres' job control, we must combine with their characteristics and transform the mode of management. To this end, this paper puts forward three Suggestions. First, create a relatively loose work environment. Under the constraints of strict discipline, the atmosphere working in troops is serious and nervous and the mode is monotonous rigid, which is likely to lead to boredom and result in a decline in job control. Aiming at this reality, the relevant units and departments to try to create a relatively loose work environment for professional technical cadres, make the work more interesting, fully mobilize the enthusiasm and initiative of them, make them to shift from "want me to work" to "I want to work", so as to improve job control. Second, strengthen the autonomy of professional technical cadres. In the persistent career pursuit of professional technical cadres, they often show distinct personality traits. Because of the work they do need imagination and open mind, and the time, methods and channels to the same work will vary from person to person, so professional technical cadres in the work are often reluctant to abide by some rules. Management and requirements to the professional technical cadres should seize the wide aspect. As to the details in the work, such as the steps to complete a professional work, the time needed to complete the work, location, methods, staffing and so on, we should try to give them more freedom without affecting the working principle and important premise, giving them broader space, rather than in the supervision and meticulous guidance. Third, let professional technical cadres participate in decision making.

We should establish the mechanism that makes the professional technical cadres to participate in the management and grant them the power of planning a major field of professional technical matters. In this way, it can promote their to full playing in the field of professional technical, arouse their work enthusiasm, produce strong ownership responsibility to forces and service for the troops better.

Pay attention to improve the professional technical cadres' compensation treatment. Increasing compensation and improving treatment is very important to stimulate enthusiasm and creativity of professional technical cadres. The author thinks that, to determine the professional technical cadres' compensation levels, the key is to realize three frames of reference: to realize social members compensation levels, to realize the national civil service compensation levels, to realize the compensation levels of administrative cadres. The empirical analysis shows that compensation structure is the most dissatisfied and the most influential important variables to professional technical cadres. How to determine the appropriate compensation treatment cannot be settled only by "rise the salary". Compensation income system should have solved the issue of efficiency. The one who work more, the one gets more. It is the internal fairness. But current compensation income system takes too much absolute fairness into consideration. Growth of military pay differences mainly derived from length of post grades, rank, difference. Although there are some regional subsidies, post subsidy standard, etc., the species is little and standard is average. It's difficult to accurately reflect the technology needed to content in different positions and to pay the amount of labor, difficult to really reflect internal fair. And it is not conducive to mobilizing the enthusiasm of soldiers. Therefore, in order to reflect internal fairness, the pension system should be reformed. Compared with regional allowances and post allowance, informative benefit is seriously deficient. Because the demand of military informative allowance is implicit, it is difficult to reflect directly in normal times. We can draw lessons from foreign experience, adjust military allowance policy, increase the kinds of knowledge benefits and improve the level of knowledge allowance standard.

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RESEARCH ON BENEFIT-ORIENTED MECHANISM OF MILITARY-CIVIL INTEGRATION

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Abstract: *In the market economy, using multiple methods such as administrative, economic or legal means to promote integrated military and civilian development is quite essential. However, at present, a relative lack of economic means in the optimization of resource allocation entails further improving benefit-oriented mechanism in the integration development. It is therefore highly significant for units or individuals to inspire their enthusiasm and initiative by means of benefit-oriented mechanism in the integration development. The benefit-oriented mechanism of integrated military and civilian development mainly involves that how to lead investments, technologies and forces in the social domain flowing into national defense construction through economic benefits, and vice versa, how to transform the achievements of national defense into civilian use, so as to maximize the benefits between enriching the country and strengthening the military. It includes specifically investment-financing oriented mechanism, military procurement benefit-oriented mechanism, tax-deductions benefit-oriented system, and loss compensation benefit-oriented mechanism.*

Keywords: *community, intercultural context, communication*

1. INTRODUCTION

Market economy is premised on admitting independently material benefits of different regions, departments and individuals.

And the nation would ensure all the market participants equal legal status and rights to development.

Under the market economy, all the market entities compete for self-interests and thus promote the transfer of economic resource among different regions, departments, military and civil sectors, and enterprises.

It is clear that maximizing the benefits is the main reason for the behavioral change of market players, through formulating regulations and policies in favor of military-civil integration, market participants will be guided to promote military-civil integration in the process of maximizing their self-interests.

Benefit-oriented mechanism for military-civil integration is a policy system which under the condition of socialism market economy, leads the market participants consciously on their way to military-civil integration by the material and spiritual motivation, solve the problem of military-civil separation, and fully promote integrated development of military and civil sectors according to the requirements of scientific outlook on development.

Market economy in China has only a short history, in optimizing configuration of resources the economic means utilized is not enough, and therefore, it will be of important significance to strengthen initiative and enthusiasm of regions, departments and individuals by establishing, improving and more depending on benefit-oriented mechanism to promote military-civil integration.

Research on benefit-oriented mechanism of military-civil integration

The connotation of benefit-oriented mechanism of military-civil integration is quite rich, and at present we should focus on establishing and improving the mechanisms as follows:

2. BENEFIT-ORIENTED MECHANISM OF INVESTMENT AND FINANCING

Whatever is major infrastructure construction, or key science and technology project, input of huge funds is imperative.

And thus capital investment is material foundation to drive the integration of military and civil sectors.

Since China's reform and opening up, it deepens reform of the investment and financing system and initially forms the scenario of diversified sources of investors, various channels of funds, diversification of investment way and project construction.

But for major infrastructure projects especially defense projects, public finance is the main source for financing.

Under the condition of diversification of investors and financiers, through increasing investments in key military-civil compatibility projects, the nation would not only directly support construction of these projects but also attract parts of social funds into projects conforming to the direction of military-civil integration by the demonstration and guiding function of fiscal investment.

Seen from the practice of military-civil integration in developed countries, they all have funds specially designed for key projects of military-civil compatibility which would draw matching funds from local government and enterprises.

For example, DOD's expense in developing military-civil integration in US mainly comes from government, armed forces and enterprises.

As for the expenses of dual-use technology projects in DOD, Government dual-use technology office and the US Army each takes up 25% of all the expenditures, enterprises involved assume 50% of expenditures.

Currently, it is important to improve policies in five aspects in order to yield leading and propelling functions of investment and financing policies on military-civil integration.

First, increase the degree of direct investment.

Key military-civil integration projects which have been enrolled in national special plans and key infrastructure construction projects possessing strong military-civil universality which has been listed in transportation and communication pivotal projects planned by nation, should be incorporated in the state budget and granted with partial or whole financial support by the way of direct investment.

Second, increase the degree of capital input. Nation should inject capital fund into State-owned and state-controlled military-civil integral enterprises, increase their business assets, and help them solve problems of insufficient funds.

Wen Chuan earthquake has caused damage of above 30 trillion Yuan for central enterprises, nation by issuing special state bonds instilled funds into seriously damaged and operationally difficult enterprises and preferentially subsidized high-tech enterprises with high degree of military-civil integration, and made them resume production in a relatively short period of time.

Third, step up the strength of fiscal subsidy.

It is of strategic significance to arrange special funds and offer subsidy less than 50% of the total amount by central government for high military-civil compatible projects, such as aerospace, aviation, nuclear technology, marine technology, new material technology.

Fourth, establish discounted loan system.

According to the requirements of developing military-civil integration, the government should offer discounted loans to small to medium private enterprises which develop dual-use technology, and help them alleviate the pressure of R&D funds. The discounted loans are issued by banks, and fiscal departments grant the interest subsidy. Fifth, send up the strength of financial support.

When it concerns with the key military-civil integrated projects, financial and guarantee institutions should provide financial support with a high priority.

When increasing fiscal support for integrated development, meanwhile we should further deepen investment system reform of defense industry, speed up forming a new type investment system in which government regulation effective; social capital involved; intermediary services standardized; supervision and administration powerful; military and civil sectors benign interactive.

Through improving policies and regulations, we can ensure social capital profit in the military-civil integration project and induct social capital flowing into military-civil areas. Since china's reform and opening-up, we have accumulated large-scale social funds.

By the end of 2011, the balance of Renminbi and foreign currency deposits in financial institutions amounted to 82 trillion Yuan, the total market capitalization of Shanghai and Shenzhen stock market reached 24 trillion Yuan, Private capital totaled 40 trillion Yuan.

Therefore, it has a broad space to guide social capital into military-civil integrated projects by innovating investment and finance system.

3. Benefit-Oriented Mechanism of Military Procurement

Military procurement means that the army regularly purchases weapons and equipment and other military materials for performing military functions.

Military procurement constitutes important part of government purchase, and takes up great proportion of defense expenditure.

Statistics show that during the 11th five-year plan, the total amounts of equipment procurement amounted to 762.4 billion Yuan which occupy 32.7% of defense expenditure.

If adding military projects and general material purchasing, it accounts for over 50% share of defense expense.

It is self-evident the huge scale of military purchase would exert great effect on market entities.

Under the condition of market economy, more orders obtained from the armies, more profits the enterprise will earn.

Hence the country can lead enterprises to take the road of military-civil integration by controlling prices, quantities, categories of military goods.

3.1 Improve military market access system. With the rapid development of civil technology, many countries have realized fully utilizing achievements and resources in civil sectors for the purpose of defense construction is an important means to improve efficiency of economic resources.

In 2003, the road map of defense industrial transformation published in US emphasized that it is imperative for small to medium enterprises entering into defense area, changing the status of market monopoly by several major contractors and forming a new type of military market with numerous big or small suppliers.

In contrast in China, there still exist closed and narrow market, difficult entering into military market for small to medium enterprises.

We should on the one hand revise the military production license category, abolish discriminatory policy impeding the entrance and create fair policy environment for all enterprises, on the other hand, we should reformulate military-use standard, adopt advanced civil standards, and drop the threshold of the military market.

3.2 Improve preferential purchasing system. Giving support to high-tech enterprise by the means of government procurement is a general practical experience by major countries in the world.

We can use these experiences to support military-civil integration enterprises with good prospect.

Under the same condition, the army gives priority to purchase their products and thus enlarge their market share.

In the early stages of business development, some high-tech corporations are confronted with insufficient demand, since people lack of knowledge about their products.

Research on benefit-oriented mechanism of military-civil integration

If the armies can purchase their products in time then they can survive and win the opportunity of further development and this behavior can bring demonstration effect for high-tech enterprise capable of independent innovation.

For example Motorola Corp. developed Iridium star telephone communication system which composed of 77 satellites in 2000.

At first, the operating cost is very high and customers are limited, the corporation faced with bankrupt. The US Army in order to support satellite phone, signed a 252 million dollars contract and helped Motorola out of trouble, at the same time, greatly promote the development of satellite phone.

3.3 Improve the procurement system of competitive selection.

Competitive purchasing can motivate suppliers update their equipment using advanced technology, and also a main way of procurement adopted by US Army. US "competition report of DOD in 2008 fiscal year" shows that in the past decade, the ratio of competitive procurement averaged 61%, the ratio of competitive purchasing contract keep at around 80%. Compared with US Army, the share of competitive equipment purchasing contract in Chinese troops is much smaller, hence it needs to expand the scope of competitive purchasing, and by the way select excellent enterprises as the suppliers.

The most important in the practice is to cut down administrative means, resorts to market power and increase the ration of competitive purchasing contracts.

3.4 Improve the military pricing system.

We know in the military product market, army is the sole buyer, and a few monopoly enterprises are product sellers, so government can intervene in the price making of military goods.

Since the price of military goods directly determines the benefits gained by all the market participants, nation can adjust enterprise entrance and exit of the market by controlling the price. Japan Defense Agency reaches the agreement with main defense enterprises at a price level 30% higher in order to attract and encourage the civil enterprises engaging in military product.

While in China, the price making system now still belongs to the way of planned economy, military production profits are set uniformly by the government, not subject to market competition.

It goes against attracting high-quality private enterprises to enter the military market and against weed out backward production capacity. Deepen military pricing system reform is to form a pricing model of the social average cost plus differential profit.

Generally, military production has characteristics of high-technology, technical exclusiveness and limited scale, military production margins should be higher than civilian production.

Meanwhile, the differential profit margins for different military goods can inspire and guide more civil enterprises to participate in the development and production of military goods, and defense industrial enterprises can develop and use more dual-use high technologies and products.

4. BENEFIT-ORIENTED SYSTEM OF TAX DEDUCTIONS

It is common practice of world's major countries to relatively increase revenue of "conversion from defense to civilian", or "Converse from civilian to defense" enterprises, or enterprises engaged in the development and production of dual-use technology and product through tax relief. After the end of the Cold War, in French, shipping industry was granted with tariff-free on the imported shipbuilding materials and equipment, and the shipyards and the purchasers were exempted from VAT in order to help the shipbuilding industry insufficient of military order develop civil and international market. Korean "defense tax", "defense industry special law" stipulates that giving military industrial enterprises and dual-use enterprises tax incentives, including partial or complete exemption from customs duties, sales tax, VAT, etc. Russian Federation "tariffs Law" states: "General Contractor (contractor) grant tax-free on technology updates equipments and other products imported for defense procurement."

In recent years, China has also implemented a number of tax policies to promote the development of civil-military integration, such as income tax exemption on high-tech enterprises for two years and later income tax levied by half; waiving part of the defense industry enterprises VAT and land use tax; national defense scientific research units exempting from sales tax for the revenue of technology transfer and so on.

However, the existing preferential tax policies are not fully adapted to the requirements of civil-military integration and needs further improvement.

One is carrying out a unified tax policy for enterprises engaged in the development and production of military goods.

On the one hand, government should allow all kinds of civil enterprises, institutions bearing weaponry research and production enjoy tax exemption on VAT and land use as military enterprise does, simplify the tax management process;

On the other hand, the state should take full account of confidentiality and particularities of military enterprises in identifying high-tech enterprises, and make provision corresponding to military enterprises' reality in the scope of certification, intermediary auditing, intellectual property, etc. and make qualified military high-tech enterprises enjoy the same tax incentives as the civil high-tech enterprises.

Second, the government should study and formulate new tax policies to promote the development of military and civilian integration, such as drafting tax policy of high civilian-military compatible, high-end manufacturing, information industry, aerospace industry, marine industry, new energy industry; increase tax incentive supporting industrial upgrading of defense technology industry; implement tax policy promoting civil-military forces of science and technology to carry out joint research on key technologies, two-way conversion and application of advanced technology; introduce tax policy supporting medium to small enterprises to participate in military R&D; further promote the implementation of tax policy of military socialization.

Third, increase international cooperation of defense industry, using international resources to strengthen tax policy support on national defense construction.

For imported equipment in favor of coordinating economic development and national defense building, the state should adopt appropriate relief on VAT or other tax preferences, reducing the pressure on corporate financing.

5. BENEFIT-ORIENTED MECHANISM OF LOSS COMPENSATION

Whatever economic development taking into account the needs of national defense, or defense construction taking into account the economic needs, we need to increase construction costs.

In a market economy, civil construction projects will add cost due to the consideration of defense demand, and vice versa. If additional cost cannot be compensated, it will definitely affect enthusiasm and initiative of the local government, military departments and related enterprises to take the road of civil-military integration.

Therefore, to promote the development of military and civilian integration, we must follow the requirements of market economy, establish and perfect the mechanism of benefits loss compensation.

First, we must establish a loss compensation mechanism of economic structure taking into account the interests of national defense.

Economic layout with defense needs is the responsibility of all levels of government, but the central and local government take tax-distribution system, national defense requirements will increase additional spending of local government, affecting local government's enthusiasm of considering defense needs, such as bringing border cities and scenic spots into the prohibited zone; dispersedly layout concentrated production capacity etc., this will increase construction costs or affect the economic gains. Therefore, central government through transfer payments and other ways should give reasonable compensation for the benefits loss caused by the economic layout taking account of defense demand.

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Second, establish a loss compensation mechanism of major infrastructure with defense needs.

Energy, transport, communications, water conservancy, urban utilities and steel, nonferrous metals, petroleum, petrochemical, equipment manufacturing and other departments are all closely related with national security.

In these sectors, the massive infrastructure construction, such as highways, civil airports and ports, subway, power plants, communications hub implementing defense demand, will increase construction costs and impacts interests of related departments.

Under the condition of diversified investors, the central government should give a reasonable compensation for the additional costs and benefit loss through the central government direct payments or establishing special funds of large-scale infrastructure with defense demand.

Third, establish and improve the benefit loss compensation mechanisms of military mobilization enterprise.

Military mobilization enterprise usually refers to reserving military production capacity in peacetime and converting all or part of production capacity to military goods in times of war, including military enterprises with civilian production tasks, also civilian enterprises with military production tasks.

Military mobilization enterprises usually reserve military production capacity which needs to increase construction and maintenance costs, such as the use of flexible technology to make civilian production line having military production capacity; through sequestration of production line, there are plans to limit production to save part of the high-tech weaponry production capacity; enterprise reserve balance defense demand and so on.

In a market economy, economic benefits loss of the military mobilization enterprises caused by reserving military production capacity production capacity in peacetime, the state should through direct and indirect compensation, material and funds compensation, economic and non-economic compensation and other means, give reasonable compensation and encourage more enterprises to actively take obligations of reserving military production capacity in peacetime.

The fourth is to establish compensation mechanism for benefit loss in non-war military operations.

Military expenditure is special funds for a country to guarantee military construction and war in a given period.

In the new era, the army needs to respond to various security threats and accomplish diverse military tasks, apparently material and financial resources consumed in the non-war military operations are difficult to get full compensation from the military expenditure, need to get full compensation by increasing the budget of the national government expenditure.

In recent years, our army participated in flood, earthquake relief, Somalia escort and other non-war military operations, invested a lot of material and financial resources.

Although compensated, but the relevant policies, regulations and normalized compensation mechanism still need to be improved.

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ON RISKS IN DEFENSE INVESTMENT STRATEGIES UNDER THE CONDITION OF DISCONTINUOUS CHANGES

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Abstract: *This paper addresses the critical strategy of allocating resources to deal with current and future discontinuities in the security environment. In the transforming era from mechanization to informations, new rapidly advancing technologies and an array of adversaries are combining to present very different kinds of challenges to China's security. Hence, the present investment strategy is developed under conditions of relatively high uncertainty than before. Discontinuities can be viewed as inflection points, or major shifts in the military completion; which can be stimulated by several factors, such as new military capabilities, war fighting concepts and organizational structures that together bring about a military revolution. Discontinuities are often difficult to predict, both in terms of when they will occur and how they will influence the character of warfare. Thus militaries can incur severe penalties if they fail to transform, or if they pursue the wrong transformation path. The objective of any defense investment strategy is to minimize the overall threat to national security. The ability to do this is limited by risk and uncertainty. Through knowing types of risks in investment strategies, which are consist of temporal, geopolitical, technical, operational, institutional, intelligence and fiscal risks, defense strategists should improve the flexibility to allocate investments across warfare areas. During periods of discontinuous change, defense planners are confronted with the need to affect large-scale changes in military capabilities, doctrine and structure, i.e., to transform the military.*

Keywords: *uncertainty, discontinuous, risk, investment strategy, contingency*

1. INTRODUCTION

Defense investment strategies are a matter of timing and balance, as well as resources. Defense planners have four major investment categories: personnel, operations and maintenance (O&M), procurement, and research and development (R&D).

Some investments, such as personnel funding that pays the salaries of service members, and funding to support current operations and maintain equipment, realize an immediate payoff in the form of sustaining the near-term readiness of the existing force structure. Other investments, like those associated with procurement, have a longer-term payoff, as new equipment will provide a return in the form of military capability for a number of years. Research and development provide no immediate payoff, as they involve investing in new capabilities that may take a decade or longer to yield a new military capability.

Defense planners must strike a balance between investments that offer near-term capability with those that promise a payoff at some point over an extended period of time. Simply put: How much risk should be accepted now to reduce risk later? How much of our investment can be diverted to reduce the dangers we confront at this moment?

For defense planners, a key aspect of strategy involves making choices as to how limited resources can best be used to provide for the nation's security. The concept of "investment" can be viewed as sacrificing current consumption (i.e., buying more capital stock currently in production, or maintaining the current force structure) in order to acquire a greater military advantage at some future point in time (e.g., by updating the national training infrastructure; improving military education; or increasing funding for research and development — to include developing the industrial capacity for new systems and capabilities).

On risks in defense investment strategies under the condition of discontinuous changes

While the Chinese military dominated “traditional” (i.e., conventional) warfare, very different kinds of challenges have emerged in the form of “irregular” and “asymmetric” threats to Chinese security.

The implication is that the defense planners must continue transforming the military by shifting the relative weight of defense resource allocations away from “traditional” areas of military competition and toward those that address recent (i.e., “irregular” and “asymmetric”) and longer term discontinuities in the competition.

The former can be termed “reactive transformation,” in that it involves major shifts in investment priorities only in the wake of a new threat.

The latter can be termed “anticipatory transformation,” in that the Chinese military attempts to “transform” quickly enough to counter a threat before it materializes.

2. STRATEGY FOR DISCONTINUOUS CHANGES

2.1 A New Competitive Environment: Discontinuous Changes. Now we are in the transforming era from mechanization to information, new rapidly advancing technologies and an array of adversaries are combining to present very different kinds of challenges to China’s security. Hence, the present investment strategy is developed under conditions of relatively high uncertainty than before. The investment is more oriented on forces specifically designed for unconventional or nuclear warfare. In traditional warfare, new military systems were bought in large quantities to maximize economies of scale (i.e., to minimize unit cost). However, such kind of improvements in capabilities is still evolutionary, which is not quite suitable for today’s fast-paced environments.

Therefore, a good strategy should be made under the condition of understanding circumstances around well, which means defense strategists must consider how the capabilities generated by today’s investments as well as what we will confront in the future.

It is obvious that emerging threats could be little more than a nonlinear extrapolation of the threats it confronts today, which could be named as DISCONTINUOUS changes. This is the case in three aspects:

First, the Chinese military is already engaged in reactive transformation efforts as a consequence of the discontinuity induced by information transformation in west countries.

Second, rapidly advancing technologies, especially in the areas of information, communications, and computation; the biosciences; cognitive sciences; robotics; nanotechnology and directed energy offer the prospect of greatly improved military capabilities, even in the absence of a discontinuous shift in the threat environment.

Third, owing to key geopolitical and military technical trends, the threat environment will experience additional discontinuities over the next few decades.

2.2 Reasons for Forming Discontinuities. Discontinuities can be stimulated by several factors, principal among them a combination of new military capabilities, war fighting concepts and organizational structures that together bring about a military revolution.¹

One example of a military discontinuity is the revolution in naval warfare during the 1920s and 1930s, stimulated principally by rapid advances in aviation technology that enabled aircraft carriers to supplant battleships as the preeminent form of military power at sea.²

2.3 Importance of Realizing Discontinuities. Discontinuities are often difficult to predict, both in terms of when they will occur and how they will influence the character of warfare.

Consequently, during periods of great military discontinuity, or military revolution, the level of risk and uncertainty is considerably higher than that during periods of evolutionary change. Thus militaries can incur severe penalties if they fail to transform, or if they pursue the wrong transformation path.

Another barrier to anticipating discontinuities is that, as in the commercial sector, the newly dominant force characteristics tend to underperform legacy force characteristics in at least one key area of the passing military regime.

As Clayton Christensen has observed: disruptive technologies, though they initially can only be used in small markets remote from the mainstream, are disruptive because they subsequently can become fully performance competitive within the mainstream market against established products³.

Discontinuities typically result not only in a precipitous decline in the effectiveness of certain military forces/capabilities, and in the capital stock assets associated with them; but also in some emerging military capabilities ascending rapidly to positions of prominence. In this case, for those militaries that pursue anticipatory transformation, discontinuities can be sources of great opportunity.

3. RISKS IN DEFENSE INVESTMENT STRATEGY

The objective of any defense investment strategy is to minimize the overall threat to national security.

The ability to do this is limited by risk and uncertainty. Risk is randomness with knowable probabilities; i.e., we have some sense of what the probabilities might be (e.g., low, medium, high).

Uncertainty is randomness with unknowable probabilities.⁴

Both risk and uncertainty impose costs on Chinese defense investments. Costs are incurred because an investment strategy simply cannot take into account all the myriad factors that will shape the future competitive environment. Some adjustments to the defense program will inevitably be needed to correct mistaken assumptions concerning the future.

Clearly one key to successful investing in periods of discontinuity is an ability to identify what kinds of risks should those charged with developing investment strategies take into account.

3.1 Temporal Risk. Temporal risk pertains to a military's ability to react and adapt with sufficient speed to new challenges or discontinuities. The greater the temporal risk, the greater the need for an investment strategy to hedge against surprise.

3.2 Geopolitical Risk. Geopolitical risk concerns the prospect of significant shifts in alliance relationships, which could deprive China of significant military capability in the form of allied military assets, overflight rights, etc.

3.3 Technical Risk. Technical risk addresses the problem that arises if calculations regarding the enemy's access to new technologies and military capabilities prove overly optimistic or pessimistic.

The same concern exists with technologies/capabilities that defense strategists believe will be introduced into the force.

If assumptions with respect to the pace of development and diffusion of key technologies prove wrong, the effects on the China's defense posture could be substantial.

3.4 Operational Risk. The problem associated with operational risk involves assumptions regarding the effectiveness of military doctrine against existing and emerging threats.

The US Army, for example, is asserting that its Future Combat Systems, whose anticipated cost exceeds \$150 billion, is well-designed to conduct operations in an irregular warfare environment. But the Army has yet to demonstrate this convincingly.⁵

3.5 Institutional Risk. The risk here is that military institutions may guess incorrectly concerning the type (and number) of leaders and Service members needed to compete effectively following a discontinuity, or that they fail to develop the training infrastructure needed to support this development.

3.6 Intelligence Risk. There is risk associated with the ability to understand the competition. Errors here can lead to major miscalculations with respect to the allocation of resources. Indeed, the better one understands one's rivals, the less likely one is to be surprised by a discontinuity in the character of warfare.

3.7 Fiscal Risk. Fiscal risk is simply the risk that the estimates made concerning the material resources necessary to execute an investment strategy. A strategy works only if the means it requires are available to achieve the ends it seeks.

On risks in defense investment strategies under the condition of discontinuous changes

After assessing all of these risks, a judgment call must be made by senior defense officials as to what investment strategy minimizes the overall risk to national security and over what time frame. In seeking economies, they must also judge how much risk can be accepted without allowing the defense posture to slip below the minimum acceptable level.

Where uncertainty and risk are relatively high, there is a greater need to invest in hedging positions that create capability options for a wide range of contingencies.

The flexibility to allocate investments across warfare areas almost be a key element of a well-crafted investment strategy.

During periods of discontinuous change, defense planners are confronted with the need to affect large-scale changes in military capabilities, doctrine and structure, i.e., to transform the military.

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ON MILITARY TECHNICAL COOPERATION IN THE PERSPECTIVE OF NATIONAL SECURITY

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***Abstract:** National security is state affairs. To maintain and expand national security interests, the present paper analyzes military technical cooperation in the perspective of national security from both positive and negative aspects. On this basis, the direction and emphasis of military technical cooperation in the developing countries are put forward hereof.*

***Keywords:** military technical cooperation; weaponry development; national security*

1. INTRODUCTION

Since the national security is state affairs, maintaining and expanding national security interests is correlated to the survival of a state. The weaponry construction plays an irreplaceable role in national security maintenance. It is not only a key guarantee to maintain national security and stability, but also material base to maintain national interests and realize national security strategy. As the weaponry market was gradually withered in the world and the development cost for high-tech weaponry surged increasingly and other issues appeared after the end of Cold War, all countries, including the developed countries, held that self-sufficient weaponry development strategy had not adapted to the new characteristics of existing market demand, therefore, international military technical cooperation could yet be regarded as an ideal strategy to effectively respond to the new change of weaponry market demand. The military technical cooperation, apart from associated research and development of weaponry, also includes weaponry procurement, technology introduction, etc. Nowadays, with rapid development of science and technology and gradual deepening of economic globalization, the broad application of military technical cooperation has been the basic policy orientation for different countries to strengthen weaponry construction and strive for national security.

2. THE BROAD APPLICATION OF MILITARY TECHNICAL COOPERATION IS THE PRACTICAL NEED TO MAINTAIN NATIONAL SECURITY

The military technical cooperation is an outcome emerging with the advancement of times.

The new revolution in military affairs is gradually promoted so as to make weaponry—material base to maintain and expand national security interests increasingly complicated, as a result, traditional self-sufficient weaponry strategy can not adapt to the new situation of weaponry development. The international security situation is complex and changeable, thus, different countries are confronted with increasingly severe security situation and it is a further arduous task for each country to maintain and expand their national security interests. The multiple factors are interacted so that the military technical cooperation becomes an inevitable choice for all countries to maintain and expand national security interests.

2.1 Military technical cooperation is an effective weapon for the state to boost weaponry construction. First of all, the military technical cooperation is an effective way to improve the economic affordable of weaponry development.

On military technical cooperation in the perspective of national security

Due to swift development of science and technology and their wide application in the military field, the cost for weaponry development rises substantially and the weaponry research & development is faced with increasingly high risk.

At present, as the result of high cost and high risk in the weaponry research and development, any country (even USA) in the world gets powerless for the completely independent development and manufacturing of a high-tech weapon.

Confronted with the new situation of weaponry development, different countries in the world explore the new path of weaponry development in succession in order to improve the economic affordability of weaponry development.

Through military technical cooperation of different countries, it is available to make full use of the existing technology and conditions of all participating countries and share the expenses so that weaponry development cost can be largely lowered for all participating countries.

A survey of Western European countries showed that the cost for weaponry development by two cooperating countries was 30% less than that of independent weaponry development by one country, and 50% cost could be lowered in the event of associated research and development by multiple countries.^[1]

The cost is reduced so that weaponry development risk can be lowered naturally. Since the military technical cooperation has such advantages as “reducing development cost, shortening development cycle and sharing development risk”, it has been an effective way for different countries to improve the economic affordability of weaponry development.

Secondly, the military technical cooperation is an effective measure to break through the technical bottleneck of weaponry development. With the end of Cold War, the technological level and technological content of weaponry development get higher and higher, the weapon system becomes complex increasingly and each kind of modern weapon is often the integration of various sophisticated technologies.

Under these circumstances, “there is almost no country which is leading in all key technology fields, thus, only through technology sharing based on international cooperation in national defense industry, all countries can find another shortcut to develop, manufacture and obtain further advanced weapons”.^[2]

Just for this actual situation, different countries turn to international society to overcome technical difficulty by means of scientific technology capability of other countries.

As new revolution in the military affairs is gradually promoted, the inter-state military technical cooperation is clearly accelerated, the cooperation field and scope are continually expanded and the cooperation level is gradually enhanced so that military technical cooperation becomes an indispensable part of weaponry development and production for many countries.

Thirdly, the military technical cooperation is a strong guarantee for the developing countries to strive for late-developing advantage and reach weaponry spanning development.

For the developing countries, weak economic foundation and backward science and technology are actual situations they must confront.

On the basis of backward national defense technology industry, the self-sufficient technology for weaponry development is unrealistic and unavailing.

Especially nowadays with rapid development of science and technology and quick change of military technology, the developed countries even feel powerless for self-sufficient weaponry development strategy so that they have to seek for inter-state military technical cooperation to offset their strength.

Let alone the developing countries, they can not be comparable to the developed countries in terms of manpower, material resources, financial resources or technological level.

On this occasion, if it is expected to realize weaponry spanning development in the developing countries, it is necessary to turn to the military technical cooperation.

The developing countries, based on military technical cooperation, can digest and absorb numerous high technologies from the developed countries, ramp up national defense technology base, elevate the start of technical innovation and boost capacity improving. Currently, the technical progress has been a fundamental element to promote weaponry development. The developing countries shall firmly seize economic globalization, carry out practical and effective military technical cooperation with the developed countries and make the best use of late-developing advantage to avoid detours in weaponry development and boost modernized weaponry development.

2.2 The military technical cooperation is an effective means for the state to build peaceful development environment. The military technical cooperation generally occurs between the countries with similar ideology or close geopolitics relation and closely related to national strategic interests. The conditions of military technical cooperation determine that military technical cooperation is an influential factor to maintain national security. First and foremost, for different parties in military technical cooperation, the win-win military technical cooperation partnership makes the cooperators constitute interest community, enhance the political trust of different parties and promote all cooperators to form the strategic partnership. It is undoubtedly a heavy weight to maintain peaceful coexistence of all parties for a long term, resolve conflicts and disputes appropriately, reduce and avoid unnecessary conflicts. In addition, the interest community or strategic partnership formed due to military technical cooperation also gives a safety barrier for all cooperative parties. Especially for the developing country, the relevant military technical cooperation partner on the back will become a favorable umbrella for such developing country in international affairs and international communication. So far, the military technical cooperation has been an effective means for different countries to increase mutual benefits and to seek for the safety effect under intersection of interests and interdependency.

3. THE NEGATIVE EFFECTS ON NATIONAL SECURITY DUE TO EXCESSIVE DEPENDENCE ON MILITARY TECHNICAL COOPERATION

The military technical cooperation is also a double-edged sword. It shares weaponry development cost of all participating countries, reduces development risk and improves economic affordability. For the developing countries, excessive dependence on military technical cooperation will bring non-negligible negative effects on the national security.

3.1 The strategic interests are easily controlled and influenced by the developed countries. For a developed country, its military technical cooperation with the developing country always exists under some conditions. The developed country hardly transfers its military technology to the developing country for only economic interests. Generally, the real purpose for the developed country and the developing country to participate in cooperation is to make use of military technical cooperation as the lever to strive for strategic interests for their own country. In other words, apart from economic interests, the politics, diplomacy, culture, ideology and other aspects will be also key factors to affect the decision-making of the authority in respect of military technical cooperation between the developed country and the developing country. For instance, MIG-21 fighter was introduced by India from former Soviet Union. When the war between China and India happened, the first choice of fighter for India was not MIG-21 fighter of former Soviet Union, but F-104G fighter of USA. However, the request for privileged imitation production line with weaponry introduction proposed by India was rejected by USA at that time. American government held that India which was powerful and self-reliant in military affairs did not conform to the strategic interests of USA. Nevertheless, the authority of former Soviet Union maintained that the coordination with India as “non-aligned leader” was an indispensable condition to battle for world supremacy with USA.

On military technical cooperation in the perspective of national security

Based on common strategic interests, former Soviet Union not only agreed with India's request for introducing production line, but also supplemented numerous favorable measures.^[3]

Therefore, considering that the strategic interests and sovereign act of the developed countries are of selfishness, the strategic interests and sovereign act of the developing countries will often be controlled and influenced by the developed countries during their military technical cooperation with the developed countries. In that case, the developing country, which depended on the military technology of developed countries excessively, would lack the right to speak in international affairs and also autonomy in international communication so that developing country had to take action under the baton of the big power and became a political subordinate to the big power in international affairs.

3.2 The weaponry development is possibly controlled by others. For the developing country, the military technical cooperation in wide application can promote weaponry spanning development and improve weaponry development capability.

If one country blindly emphasizes the military technical cooperation with the developed country and neglects autonomous innovation, the weaponry development in this country will be controlled by others finally.

Since the beginning of independence, India has insisted on the weaponry development strategy "learn strong points from others, incorporate and absorb diverse things, use by ourselves".

Just based on such development strategy, India can be developed from a country with backward technology, weak foundation and insufficient resources to a regional major military country in merely a few decades.

However, the major military country is not equivalent to the military power. Compared with the beginning of independence, Indian weaponry productivity is greatly improved, but there is still a long way to realize weaponry self-sufficiency.

The primary cause is that, under the guideline of Indian weaponry development strategy, Indian weapon production system is established on the technical or capital support of one country or several countries.

Its development is of no independence or autonomy, which will surely make Indian weaponry development blindly follow others and be controlled by others.

India once made great efforts to develop light combat aircraft (LCA), but the light combat aircraft could not be put into production as the result of technical sanction by USA for India and other factors, which was a typical case of weaponry development controlled by others.

3.3 Resulting in the technological dependence on the developed countries. One main purpose of military technical cooperation between the developing country and the developed country is to introduce the advanced technology which can not be acquired independently by one country or which a long term must be spent on.

This technology introduction can rapidly lay a foundation for weaponry development and improve weapon system in the developing country in a short term.

However, the technologies from the exporting country have been mature and they will be inevitably eliminated as the scientific technology advances.

When there is no technological base for research and development in local country, such developing country has to purchase the mature technology again.

If this situation is continued, the country of technology introduction will be trapped in a vicious cycle of "introduction—backward technology—reintroduction—backward technology".

Consequently, it is difficult for the developing country to realize autonomy and innovation in technology.

4. CONSIDERING NATIONAL SECURITY AND STABLY PROMOTING MILITARY TECHNICAL COOPERATION

Although the military technical cooperation is a successful experience for weaponry construction in the developing country, under the background of changeable international strategic pattern and gradual deepening of new military revolution, it is required to review previous achievements and experience in development perspective, consider the new situation of weaponry development, innovate the idea and hold the key point, in terms of the military technical cooperation.

4.1 The emphasis of military technical cooperation shall be on the introduction of sophisticated technology. If the weaponry development history of the developing countries is surveyed, it is easily realized that military technical cooperation is always an effective way to boost modernized weaponry construction.

The military technical cooperation not only improves the start of weaponry research and development in these countries, but also avoids possible detours in weaponry development. With the deepening of new military revolution, the conditions and background of military technical cooperation have profound changes. During military technical cooperation, the developing country shall fully learn and absorb former experience, do something but not everything in principle and focus on advanced core or key technology in the cooperation, especially key technology fields such as weapon system optimization, operational efficiency improvement of weapons and system operation capability, etc. The ways of cooperation shall be changed from equipment introduction to special technology introduction, mutual research & development, cooperative production and other aspects to reinforce weaponry development capability through cooperation.

4.2 The secondary innovation upon technology introduction must be emphasized. The developing country, through military technical cooperation, can certainly introduce technology and improve weaponry technological level.

However, if the developing country always introduces technology blindly, but not absorbs these technologies or conducts innovation, the weaponry development will only follow others passively, the surpassing will be impossible and finally its weaponry development will be controlled by others. The intrinsic attributes and essential characteristics of weaponry development determine that the weaponry development can not exist without independent innovation and the independent innovation shall be the eternal subject for weaponry construction and development. As the economic globalization is gradually accelerated, inter-state military technical cooperation has been an important part of weaponry construction for all countries. Based on the antagonism of military field and the need to maintain national security interests, we argue that the core technology can not be bought. Even if it is bought, there will be potential safety hazard; technological imitation is not a long way but only brings short-term benefit; the technology introduction is not practicable either for dependence on others must result in control by others, the weaponry development finally relies on independent innovation and the independent innovation is the root of weaponry development. Therefore, the innovation based on technology introduction must be valued in the military technical cooperation, which is a strong guarantee to promote sound military technical cooperation and also a strategic demand to maintain national security interests.

4.3 The independence must be maintained in military technical cooperation. With the gradual deepening of world economic globalization, the source of advanced technology for weaponry development gets diversified increasingly and the military technical cooperation also becomes the strong power for weaponry development increasingly, but independence and self-dependence are still the fundamental principle of current weaponry construction and development. Otherwise, the weaponry development controlled by others due to excessive dependence in military technology will make such country dominated and driven by the developed country in international affairs and international communication and even fail to guarantee basic national security.

On military technical cooperation in the perspective of national security

It is extremely dangerous for the developing country. As to the developing country, it is not feasible to keep self-seclusion in weaponry construction or place all hopes on foreign help and support. The external force can only be used for auxiliary and supplement. The external force is used as a means to promote sound development of local country and to insist on independent weaponry development. Only when the developing country insists on independence and self-dependence, concentrates on breaking through urgent and the most driving key national defense technology and improves original innovation capability of weaponry construction, the developing country can select development road independently and also ensure to hold a place in future revolution in military affairs.

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THE IMPACT OF DEFENSE EXPENDITURE ON ECONOMIC PRODUCTIVITY IN APEC COUNTRIES

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Abstract: *Evaluating the effects of defense spending on macroeconomic performance, in particular, on economic productivity is a critical issue. This study integrates Malmquist Productivity Index (MPI) with bootstrapping to establish statistical inferences that provide a complete, effective analysis of the impact of defense expenditure on economic productivity between 1990 and 2010 for APEC countries. The findings indicate that the average MPI with defense expenditure is higher than that without defense expenditure. Additionally, region based productivity analysis indicates that the appropriate allocation of defense expenditure can increase regional economic productivity effectively across Americas, Oceania and Asia. Moreover, the results further prove that the effective defense expenditure strategies undertaken by government are important for improving economic productivity of countries.*

Keywords: *Defense Expenditure; Economic Productivity; APEC*

1. INTRODUCTION

Defense expenditure is an important part of government spending on defence spending, defense spending at the same time limited by the size of the country's fiscal situation, the country's fiscal situation ultimately depends on the level of economic development. Therefore, a higher level of economic development can lead to more resources into national defense spending. De Grasse (1993) confirmed that defence spending can create jobs, increase purchasing power, to promote economic growth. Benoit (1978) demonstrated that increased defense spending is beneficial to the formation of human capital, especially in developing countries, soldiers are generally with a good physical training, and trained in a variety of military skills, which is conducive to economic growth. Moreover, Ram (1996) reviewed the defense will guide effect, whole construction machinery industry also has on economic growth, for example by building highways, airports, docks and other infrastructure to promote economic development. So, in the long run, defense spending, directly or indirectly promote the economic growth.

But the Deger and Smith (1983) in this paper, the increased defence spending will hinder the economic growth, Sivard (1996) also suggests that the same point of view, think that defence spending away from other economic activities (such as education and health spending). Safdari et al. (2011) argue that in developing countries, there is no clear correlation between defense spending and economic growth, but in industrialized countries, a one-way or two-way link between the two. Chang et al. (2011) using Feder - Ram and he Keynesian model, by studying the multinational economic development model found that defense spending is crowding out effect on economic growth. Feridun et al. (2012) further confirm although defence spending is positive or negative effect on economic growth, but the core values of defense spending is to protect national security.

Background, geographical conditions, historical development around the world differ in thousands ways of resources endowment, each country internal politics and foreign aggression levels are also different. So, the relationship between the countries on defense spending and economic growth are different.

The impact of defense expenditure on economic productivity in APEC countries

Therefore, select a representative sample of regions and countries as analysis object, dig deep relationship between, it is very necessary.

Asia - Pacific Economic currency(APEC) is important in the asia-pacific region Economic Cooperation BBS, also is the highest level of inter-governmental Economic Cooperation mechanism in the asia-pacific region. In promoting regional trade and investment liberalization, strengthen economic and technical cooperation between members played an irreplaceable role. APEC beginning in 1989, until now there are 21 member economies. APEC is created for people in the region of stability and prosperity in the future, set up the asia-pacific economic family and make great contribution to the world economy. This paper is intended to study the effect of APEC national defense expenditure to the economic productivity, temperament, summed up the intrinsic link between defense spending and economic growth.

With appropriate analysis object, also must use the appropriate research methods, in order to draw accurate conclusions. Malmquist (1953) first proposed to create "Productivity Index Malmquist the Productivity Index(MPI)" as a measure of input and output of the ratio of the distance function. There is a lot of experience to prove that the MPI only need a small amount of data you can integrate the relationship between the input and output, and relative to the other methods, the MPI program of calculation is more simple. Simar and Wilson (1999) found that MPI has allowed to contain random errors, also can obtain the advantages of effectively estimate. Therefore, this article using the MPI, and combined with the Data Envelopment Analysis (DEA) ", review of APEC countries from 1990 to 2010 defense spending impact on economic productivity.

This article structure arrangement is as follows: the first part is literature review, the second part expounds research methods, the third part introduces the sample and data collection, the fourth part describes the empirical test results, the last part is the conclusion of this article.

2. METHODOLOGY

2.1 Measuring productivity change: the Malmquist Productivity Index (MPI). MPI is by Malmquist (1953) first put forward, over the years, through with Caves, et al. (1982) and Fare et al. (1994) as the outstanding representative of many scholars research and improvement, has now evolved into model for total factor productivity growth, reflecting the effectiveness of the process and the return of the multiple input and output process. MPI computing is in all factors of production (Total Factor the Productivity, TFP) under the condition of, changes in production (Efficiency Change, hereinafter referred to as EC) and Technical Efficiency Change, Technical Change, TC) for short. Assume that in every period, the state's production levels are saturated production status. As shown in equation (1), when the MPI values greater than 1 indicates that growth in productivity. When the MPI values less than 1 indicates that a drop in productivity.

$$MPI = \left[\frac{D^{t_2}}{D^{t_1}} \right] \times \left[\frac{D^{t_2}}{D^{t_1}} \times \frac{D^{t_1}}{D^{t_2}} \right]^{\frac{1}{2}} = EC \times TC \quad (1)$$

MPI equation calculation is similar to the DEA, main is to use linear equation is calculated. Benefit from the DEA effective marginal analysis skills, MPI equation and the parameters in the display is as follows:

If there are $j = 1, L, n$ countries, in $t = t_1, t_2$ two time period, use of $X_k^{t_1} = (x_{1k}^{t_1}, x_{2k}^{t_1}, L, x_{pk}^{t_1})$, $i = 1, L, p$ kind of investment, production $Y_k^{t_1} = (y_{1k}^{t_1}, y_{2k}^{t_1}, L, y_{qk}^{t_1})$, output $r = 1, L, q$. Fixed returns orientation into DEA linear equation as shown in (2) - (5), equation (2) and (3) display is in a period of observation changes the marginal productivity of at some point, equation (4) and (5) display is relative to a period of observation the marginal productivity of at some point within a period of time before change. Equation (2) - (5) involving parameter must be one country in the two phase over the time period of data.

$$D^{t_1} = \underset{\theta, \lambda}{Min} \theta$$

$$\begin{aligned}
 st - y_{rk}^{t_1} + \sum_{j=1}^n \lambda_{kj}^{t_1} y_{rj}^{t_1} &\geq 0, r = 1, L, q \\
 \theta x_{ik}^{t_1} - \sum_{j=1}^n \lambda_{kj}^{t_1} x_{ij}^{t_1} &\geq 0, i = 1, L, p \\
 \theta, \lambda_{kj}^{t_1} &\geq 0
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 D^{t_2} &= \underset{\theta, \lambda}{\text{Min}} \theta \\
 st - y_{rk}^{t_2} + \sum_{j=1}^n \lambda_{kj}^{t_2} y_{rj}^{t_2} &\geq 0, r = 1, L, q \\
 \theta x_{ik}^{t_2} - \sum_{j=1}^n \lambda_{kj}^{t_2} x_{ij}^{t_2} &\geq 0, i = 1, L, p \\
 \theta, \lambda_{kj}^{t_2} &\geq 0
 \end{aligned}
 \tag{3}$$

$$\begin{aligned}
 D^{t_1} &= \underset{\theta, \lambda}{\text{Min}} \theta \\
 st - y_{rk}^{t_1} + \sum_{j=1}^n \lambda_{kj}^{t_1} y_{rj}^{t_1} &\geq 0, r = 1, L, q \\
 \theta x_{ik}^{t_1} - \sum_{j=1}^n \lambda_{kj}^{t_1} x_{ij}^{t_1} &\geq 0, i = 1, L, p \\
 \theta, \lambda_{kj}^{t_1} &\geq 0
 \end{aligned}
 \tag{4}$$

$$\begin{aligned}
 D^{t_2} &= \underset{\theta, \lambda}{\text{Min}} \theta \\
 st - y_{rk}^{t_2} + \sum_{j=1}^n \lambda_{kj}^{t_2} y_{rj}^{t_2} &\geq 0, r = 1, L, q \\
 \theta x_{ik}^{t_2} - \sum_{j=1}^n \lambda_{kj}^{t_2} x_{ij}^{t_2} &\geq 0, i = 1, L, p \\
 \theta, \lambda_{kj}^{t_2} &\geq 0
 \end{aligned}
 \tag{5}$$

2.2 Bootstrap in Malmquist productivity index. Efron and Tibshirani(1993) by the method of guidance, through repeated sampling estimate sample distribution.

This method has also been Caves, et al. (1982) and Fare et al. (1992) scholars research and praise highly. The MPI as a deterministic model, does not contain random errors, all of the error is coming from the marginal inefficiencies.

In the input oriented model, a high efficiency estimate, sometimes is close to 1.

But in the output oriented model, if certainty marginal samples has not been taken into account, the efficiency estimates will be very low.

In the related literature, to estimate the effectiveness of noise samples attention more and more high, although further studies on the efficiency of the national ignored this problem.

In cases of multiple input and multiple output, guide way is by correction of the inherent bias and provide a confidence interval to investigate the MPI point estimation sample diversity the only effective method (Simar and Wilson, 2000). Guide method of estimation process is a process by copying the data processing, repeated parameter estimation, the observed values used to estimate the true distribution (Brummer, 2001). Simar and Wilson (1998,2000) by the method of smooth curve guide, select appropriate smoothing parameters, after 3000 iterations, created out of the 95% confidence interval.

3. DATA SELECTION AND DESCRIPTION

This article studies the APEC national defense expenditure to the economic productivity, the influence of the MPI used to measure the change in the economic productivity, involves the four variables, respectively is: gross domestic product (GDP), fixed capital stock, human capital stock, defence spending. Description as shown in table 1:

Table 1 Descriptions of input and output variables in MPI model.

Classes	Variables	Abbreviation	Unit
Output	GDP	GDP	US\$ millions
Input	Capital	C	US\$ millions
	Labor	L	Million
	Defense Expenditure	DE	US\$ millions

APEC as a whole is analyzed first, research the relationship between the four variables to each other, a detailed description as shown in table 2.

Table2 The correlation coefficient between the variables

correlation index	GDP	C	L	DE
GDP	1,000			
C	0,997	1,000		
L	0,961	0,939	1,000	
DE	0,894	0,899	0,787	1,000

The impact of defense expenditure on economic productivity in APEC countries

Judgment of macroeconomic performance, depends on to the least defence spending, in exchange for the largest GDP output. As shown in figure 1, the APEC defence spending of average from 2001 to 2006 increased more obviously, is growing rapidly after 2007. Therefore, to study the effect of defense expenditure to the economic productivity is essential.

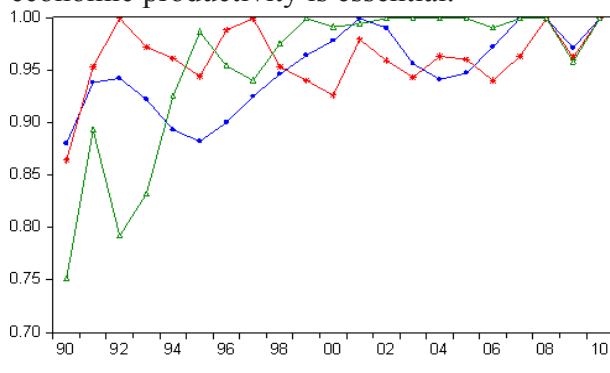


Fig. 1. Mean and standard deviation

4. EMPIRICAL RESULTS AND DISCUSS

APEC countries from 1990 to 2010, this article selects the data, first analysis excluding defence spending, fixed capital stock and human capital stock only two parameters variables, the change of GDP. Then introduces defense spending as a variable to the model, observe the change of GDP.

4.1 the national defense expenditure to the economic productivity. APEC countries on defense spending (MPI_D) and regardless of the variation of the MPI in defense spending (MPI) as shown in figure 2, can be observed, from 1990 to 1990, meter when defence spending MPI values were greater than or equal to the MPI in excluding defence spending. Especially in 2000, the gap between the two largest, up 5.4%.

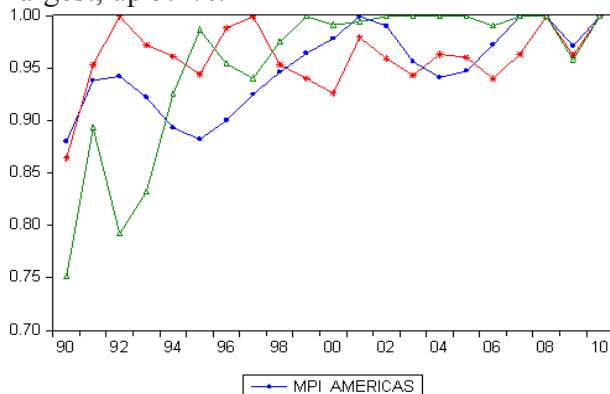


Fig. 2. Cumulative change in the MPI.

Further more as shown in table 4, when no defense spending, the median number of MPI APEC countries is 0.784, this value to reveal the APEC countries average annual productivity growth of 0.784%. At the same time, can be found that the stimulating effect of the EC for the MPI is greater than the TC.

And we can see, in defense spending, the median number of MPI APEC countries is 0.830, this value is greater than any the MPI values when defence spending, appropriate configuration of defence spending, productivity growth can promote the national economy.

The promoting effect is through a variety of means to realize. For example, through the establishment of military enterprise, create more jobs, and increase the purchasing power of workers; By perfecting the education mechanism, to improve the quality of human resources; Through a lot of infrastructure (e.g., highway, airport and wharf, etc.). Military industrial enterprises and other enterprises can establish close cooperation mechanism, promote each other, improve together, finally, reach the role of stimulating national economic productivity.

4.2 Regional defense expenditure to the economic productivity. Above is the APEC nations of the world as a whole to analyze the stimulating effect of the defense expenditure to the economic productivity, here again the APEC countries according to the location where is divided into three regions, and to do further analysis. In so doing, because competition for national governments, mainly comes from the inside of the area. As shown in figure 3, before 1998, the region's productivity change values (MPI_ASIA) below (MPI_AMERICAS) in the americas and Oceania region (MPI_OCEANIA), and after 1998, the region's productivity change value increases rapidly, more than the americas and Oceania region. Has this kind of phenomenon, the main reason is that countries generally in the two world wars in Asia suffered huge economic losses, some countries have serious internal politics, sectarian strife, the gap between rich and poor is huge, many factors are intertwined, lead to low productivity.

In gradually to the integration of politics, economy, etc., especially in the Asia countries to strengthen the internal connection, Russia and Japan and other countries increased the military production and extend the arms trade, the region's economic productivity increase quickly, and keep in a higher level of growth.

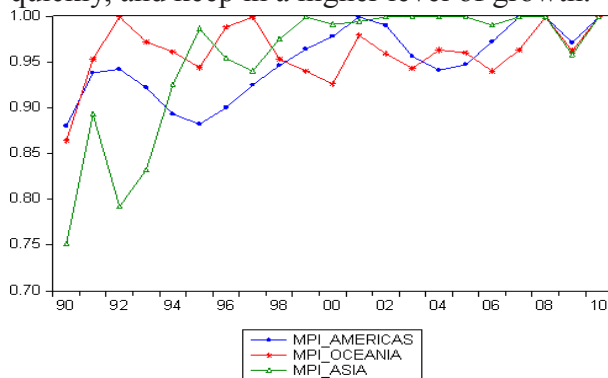


Fig. 3. Cumulative change in the MPI for three regions.

5. CONCLUSION

This article studies the impact on economic productivity on defence spending, data from APEC nations. Research shows that from 1990 to 2010, the APEC countries economic productivity growth when meter defence spending is higher than no defence spending. From the perspective of regional analysis, Americas economic productivity growth is higher than ocean states and Asian countries, this mainly comes from the United States arms trade stimulated the development of the military enterprise, drive the Americas and other countries and regional economic growth. Instead, many Asian countries since the end of the second world war, all from one year to cut defence spending. Through the analysis, the main conclusions are as follows:

5.1 Encourage private resources into national defense field. Through the above analysis, found that a country's economy will directly or indirectly benefited from the defense industry development. The organic restructuring of private and public resources, the government can through appropriate defense resources autonomy, improve the defense industry, stimulate economic growth.

Further, encourage private resources into the field of national security for weapons and equipment research and development, production, maintenance and other activities, resources equipped to the military's ability to do from short-term to long-term potential of military transformation. The government should reduce public sector investment in the defense industry, foreign procurement, increase lending to the private credit to encourage them.

5.2 Stimulate the defence industry international competitiveness. The government can through formulating the plan of "joint defence industry", such as requiring foreign companies to invest in their own or the means such as technology transfer, foreign companies for their own defense industry responsibility clearly, detailed details must be clearly written in about defense procurement, transportation, nuclear power and other specific plans. Do this is through the purpose of stimulating domestic defence industry competitiveness in the global market, and promote the development of domestic industry and stimulate the development of the economy's long-term prosperity (Dowdy, 1999). Specific incentives include technology transfer, cooperation, research and development, personnel training, to expand the international market, etc.

5.3 Strengthen the international cooperation between powerful countries. Competition in the international countries reform the industry structure, guiding the industry cooperation, mutually make up for technical shortcomings, to reduce technical protection, etc. Between countries should strengthen cooperation, especially the weak should strengthen and tactical missiles, ground attack weapons, satellite and other powerful national defence industrial base state of cooperation, to improve their status in international negotiations (Neal and Taylor, 2001).

In short, the success of management to national defense that needs to be a good coordination between the government and defense industry sector, seeking economic security and national security is the direction of the countries are trying to (Pieroni, 2009).

The impact of defense expenditure on economic productivity in APEC countries

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