Research on the Relationship Between Government Subsidies, Innovation Investment Intensity and Enterprise Value of Military Companies

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Abstract. Based on the panel data of listed companies in the Military-civilian integration board of Shanghai and Shenzhen Stock Exchanges from 2015 to 2019, this paper uses entropy weight method to optimize indicators and constructs a new enterprise value comprehensive evaluation index. From the perspective of civil-military integration, the relationship between government subsidies, innovation investment intensity and enterprise value is empirically analyzed. It is found that there is a significant negative correlation between government subsidies and enterprise value, and the current government subsidies are inefficient. However, there is no significant correlation between the intensity of innovation input and enterprise value, and the impact of innovation input on the improvement of enterprise value in the current period is not obvious. Finally, based on the research results and based on the synergy theory, relevant suggestions are put forward to enhance enterprise value and promote the in-depth development of civil-military integration strategy.

Keywords: Military industry company · Entropy method · Synergy theory · Enterprise value

1 Introduction

With the objective requirements of high-quality development, the Chinese government has increased subsidies to the military industry, and military enterprises themselves are also increasing investment in innovation, making continuous efforts in scientific research investment, attracting talents and tackling key problems. So at the current stage, what is the impact of government subsidies and innovation input intensity on the enterprise value of the company? Can they improve the enterprise value? Therefore, this paper selects panel data of 62 military listed companies in Shanghai and Shenzhen Stock Exchanges from 2015 to 2019 as samples to explore the relationship between government subsidies, innovation investment intensity and enterprise value, providing reference suggestions for military companies to enhance enterprise value and promote the in-depth development of military-civilian integration strategy.

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2 Literature Review and Research Hypothesis

2.1 Government Subsidies and Enterprise Value

There are abundant studies on government subsidies and firm value. VanPottelsberghe [1] studied the data of OECD member countries and concluded that the incentive effect was strong in the initial stage of government subsidy, while the crowding effect was enhanced after the optimal subsidy amount was exceeded. Wu Xianyun (2017) [2] took 278 listed companies in strategic emerging industries from 2010 to 2014 as the research object and found that government subsidies lagging one period were significantly negatively correlated with the financial performance and market value of enterprises, but had an incremental explanatory effect on the creation of financial performance of enterprises. As a matter of fact, in the first few years of the implementation of the military-civilian integration strategy, relevant institutional construction is in progress. The government tends to allocate resources to state-owned enterprises and politically connected enterprises, which will lead to a great difference in the military industry companies receiving government subsidies [3]. The efficiency of market-based resource allocation needs to be improved. Funded military enterprises, due to the particularity of the industry, need to follow the requirements of the national industry development strategy, strong directional investment in technology, relatively weakened the pursuit of enterprise value in the sense of the market. Based on this, this paper proposes the first research hypothesis:

H1: Government subsidies have a negative impact on enterprise value.

2.2 Innovation Input Intensity and Enterprise Value

In recent years, the research on the relationship between innovation and enterprise value has been a hot issue in the academic circle. Through literature review, it can be roughly divided into two types:

2.2.1 Innovation Input is Positively Correlated with Enterprise Value

For example, Pakes [4] investigated the relationship between R&D expenses and changes in the market value of company stocks, and found that long-term R&D activities lead to the revaluation of company stock market value, and the increase of R&D expenses leads to the increase of company stock market value. Wu Sai Sai [5] (2016) studied the relationship between innovation investment, technological innovation performance and profitability of military enterprises. It is found that innovation input is positively correlated with technological innovation performance.

2.2.2 There is no Positive Relationship Between Innovation Investment and Firm Value

Hamber [6] found through his research on enterprises funded by the US Department of Defense that the funding provided by the US Department of Defense could promote enterprises to increase R&D investment, but did not improve output efficiency. Duanjie

[7] (2019) applied the super-efficiency DEA model and Tobit model to find that the ratio of R&D personnel in China's military industrial enterprises in 2016 played a significant role in promoting enterprise efficiency, but the ratio of R&D expenditure had a reverse effect on military industrial enterprises in the short term. Based on this, the second research hypothesis of this paper is proposed:

H2: Innovation input intensity has no significant impact on enterprise value.

Through the above analysis, scholars have conducted a lot of research on government subsidies, innovation investment and enterprise value, and reached many valuable conclusions, which have made important contributions to the research in this field. However, few relevant studies focus on the military industry, and through the sorting of relevant studies, it is found that most scholars use economic indicators to measure the enterprise value, such as the return on assets and equity reflecting the performance of accounting, Tobin Q reflecting the market value, etc. Considering the particularity of military enterprises, the traditional enterprise value evaluation methods can not be fully applied to military enterprises, and the evaluation indicators need to be further improved. In view of this, this paper takes the military listed companies as the research object, uses the entropy weight method to construct the comprehensive evaluation system of enterprise value of military listed companies, uses the multiple linear regression method to study the relationship between government subsidies, innovation investment intensity and enterprise value of military listed companies, and gives the research results. Finally, some suggestions are put forward according to synergetics theory.

3 Study Design

3.1 Sample Selection and Data Sources

Considering the availability and adaptability of data, as well as the confidentiality of data of defense military enterprises, the data of listed military companies are selected as the research object in this study. Secondly, considering the implementation time of the military-civilian integration strategy, the period from 2015 to 2019 is taken as the research time interval. The data of 62 listed military industry companies of the top 10 military industry groups in Shanghai and Shenzhen are selected as research samples. During data screening, ST, *ST and sample companies with variable data missing were eliminated. Data were obtained from CSMAR database.

3.2 Variable Definition

3.2.1 Explained Variable -- Enterprise Value (EV)

Enterprise value is a comprehensive indicator affected by many factors. Through literature review, it is found that most studies on enterprise value are measured by accounting indicators, which inevitably has limitations for military enterprises and affects the persuativeness of research results. Therefore, based on the existing research, this paper measures enterprise value from four aspects: profitability, capital performance, growth

efficiency and innovation competitiveness, a total of 9 indicators. The specific value of enterprise value is calculated by entropy weight method and the index system of enterprise value is optimized and innovated.

3.2.2 Explanatory Variable 1 -- Innovation Input Intensity (R&D)

In the current research on innovation input or R&D input, innovation input is measured by R&D expenditure. However, considering the size difference of different companies, there are limitations in using absolute numbers to measure innovation input. Therefore, referring to the research of Zeng Xianju (2020), this study uses innovation input intensity: that is, the ratio of R&D expenses to operating income to measure innovation input intensity, so as to optimize the index.

3.2.3 Explanatory Variable 2 -- Government Subsidy (GS)

In this paper, government subsidies are defined as the sum of disclosed financial allocations, financial discounts and tax rebates. Then perform logarithmic processing.

3.2.4 Control Variables

In order to make the research conclusion more reliable, this paper controls other variables that may affect enterprise value, including asset-liability ratio, enterprise size, ownership concentration, ownership balance and annual fluctuation factors.

The following Table 1 lists the names, symbols, and meanings of the Table 1 variables.

Table 1. Variable Definitions.

Variable types	Variable name	Variable symbol	Variable Meaning
Explainedvariable	Enterprise value	EV	Based on entropy weight method
Explanatory variable	Government subsidy	GS	Total of fiscal allocations, tax rebates, etc.
	Innovation input intensity	R&D	R&D expenses/revenue
Control variable	Asset-liability ratio	Lev	Total ending liabilities/Total ending assets
	Enterprise size	Size	Log of total ending assets
	Ownership concentration	Scr	Total shareholding ratio of top 10 shareholders
	Ownership balance	SR	Scr/Shareholding ratio of the largest shareholder
	Company nature	Cn	State-owned is 1, non-state-owned is 0

3.3 Model Design

3.3.1 Enterprise Value Evaluation System Based on Entropy Weight Method

Entropy weight method can objectively determine the weight size. If there is a large difference in the value of the evaluation target variable on an index, the entropy value will be small at this time, indicating that the index provides a large amount of effective information, so the index should be given a high weight. On the contrary, if the numerical difference is small, the weight assigned is small [8, 9]. If there are M evaluation indicators and N evaluation objects, the original data matrix X = (xij)m × N is formed. For a certain index i, the greater the difference of index value Xij, the greater the role of this index in comprehensive evaluation. The process of determining indicators by entropy weight method is shown as follows:

a) The original data are standardized.
There are m evaluation indexes and N evaluation objects, and the original data matrix X = (Xij) M × N is formed.

$$X = \begin{bmatrix} x_{11} & x_{1m} \\ x_{21} & x_{2m} \\ x_{31} \ldots\ldots\ldots & x_{3m} \\ \ldots & x_{4m} \\ x_{n1} & x_{nm} \end{bmatrix} \tag{1}$$

The positive and negative characteristics of segment indicators need to be judged. For the indicators with greater superiority (namely, positive indicator), the treatment method is as follows:

$$r_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \tag{2}$$

For the indicators that are small and preferred (namely, negative indicators), the treatment method is as follows:

$$r_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \tag{3}$$

Generating a normalized matrix R = (rij) m × n.

b) Entropy calculation. Frequency

$$f_{ij} = r_{ij} / \sum_{j=1}^{n} r_{ij} \tag{4}$$

When $f_{ij} = 0$, let's say $f_{ij} \ln f_{ij} = 0$. In the evaluation problem with M indicators and N evaluated objects, the entropy of the ith indicator is defined as:

$$Hi = -k \sum_{j=1}^{n} f_{ij} \ln f_{ij} = 1, 2, \ldots \mathrm{m} \tag{5}$$

c) Entropy weight calculation. After the entropy of the ith indicator is defined, the entropy weight of the ith indicator can be defined as:

$$w_i = \frac{1 - H_i}{m - \sum_{i=1}^{m} H_i} \tag{6}$$

d) Indicator calculation. Calculate enterprise value composite index.
After multiplying and summing the normalized weight of each enterprise value evaluation index with the original data matrix, the comprehensive index Pj, j = 1… M.

3.3.2 Main Model Construction

$$EV = \beta 0 + \beta 1Gsi,\ t + \beta 2Lev + \beta 3Sizei,\ t + \beta 4Scri,\ t + \beta 5Sri,\ t + \beta 6Cni,\ t + \varepsilon i,\ t \tag{7}$$

$$EV = \beta 0 + \beta 1R\&Di,\ t + \beta Lev + \beta 3Sizei,\ t + \beta 4Scri,\ t + \beta 5Sri,\ t + \beta 6Cni,\ t + \varepsilon i,\ t \tag{8}$$

Model (1) is used to verify the relationship between government subsidies and enterprise value.

Model (2) is used to verify the relationship between innovation input intensity and firm value.

Among them:i represents the ith sample enterprise, t represents the time of the observed value, βj is the coefficient of each variable, εi, t is the random disturbance term.

4 Empirical Results and Analysis

4.1 Descriptive Statistics of Variables

Descriptive statistics of each variable are shown in Table 2. The maximum value of government subsidies is 29. 02, and the minimum value is 18. 90, indicating that there are certain differences between different enterprises in government subsidies. The average value of enterprise innovation investment intensity is 6. 199. Compared with enterprise assets and profits, the overall innovation investment intensity of military enterprises is moderate, but the maximum value of enterprise innovation investment intensity is 24. 19, the minimum value is 0. 190, indicating that different military enterprises attach different importance to innovation investment intensity. The average value of enterprises is 14. 17, indicating that the value level of the sample companies is relatively high on the whole, but the maximum value is 20. 77, and the minimum value is 8. 770, indicating that there is a certain gap in the value of different enterprises.

4.2 Person Correlation Analysis

Correlation analysis of each variable is conducted, and the results are shown in Table 3. According to the analysis results, there is a significant negative correlation between government subsidies and enterprise value at the level of 1%, with a correlation coefficient of −0. 420, indicating that government subsidies weaken enterprise value to a certain extent, and hypothesis 1 is tentatively verified. Enterprise innovation input intensity has no significant impact on enterprise value, and hypothesis 2 is confirmed preliminarily.

Table 2. Describes Descriptive Statistics

VARIABLES	N	mean	sd	min	max
GS	310	23. 70	1. 551	18. 90	29. 02
R&D	310	6. 199	4. 540	0. 190	24. 19
EV	310	14. 17	2. 306	8. 770	20. 77
Scr	310	30. 26	12. 82	5. 270	65. 28
Cn	310	0. 290	0. 455	0	1
Lev	310	0. 373	0. 173	0. 0400	0. 800
Size	310	32. 06	1. 540	29. 19	36. 43
SR	310	2. 162	0. 899	1. 110	4. 900

Table 3. Correlation Analysis

	EV	GS	R&D	Scr	Cn	Lev	Size	SR
EV	1							
GS	−0. 420***	1						
rd	0. 0310	0. 106*	1					
Scr	−0. 0300	0. 120**	−0. 131**	1				
Cn	−0. 433***	0. 330***	−0. 096*	0. 117**	1			
Lev	−0. 0500	0. 107*	−0. 162***	0. 146**	−0. 136**	1		
Size	−0. 281***	0. 381***	−0. 0500	0. 154***	0. 156***	0. 557***	1	
SR	0. 0490	−0. 157***	0. 0860	−0. 793***	−0. 198***	−0. 149***	−0. 197***	1

Note: ***, ** and * express significant at the 1%, 5% and 10% levels respectively.

4.3 Multiple Linear Regression Analysis

The results of regression analysis are shown in Table 4. The results show that there is a significant negative correlation between government subsidies and enterprise value at the level of 1%, and the correlation coefficient is 0. 404. Therefore, government subsidies can not effectively enhance enterprise value. Hypothesis 1 has been verified. The results also show that there is no significant relationship between enterprise innovation investment intensity and enterprise value. Innovation input is the basis for enterprises to improve their own value and strength, but the output value of innovation input lags behind,

Table 4. Regression Analysis

Linear regression

				Number of obs	=	310
				F(7, 302)	=	29.87
				Prob > F	=	0.0000
				R-squared	=	0.2963
				Root MSE	=	1.957

EV	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
GS	-.4038661	.0797298	-5.07	0.000	-.5607625	-.2469697
RD	.0141899	.0247201	0.57	0.566	-.0344556	.0628353
Scr	-.0022478	.0140684	-0.16	0.873	-.0299323	.0254367
Cn	-1.703849	.3036683	-5.61	0.000	-2.301423	-1.106276
Lev	.0724908	1.078635	0.07	0.946	-2.050102	2.195083
Size	-.2165094	.1063559	-2.04	0.043	-.4258018	-.0072169
SR	-.2557261	.1731574	-1.48	0.141	-.5964739	.0850216
_cons	31.68264	3.255889	9.73	0.000	25.27554	38.08974

Robust t-statistics in parentheses

*** p<0. 01, ** p<0. 05, * p<0.

resulting in no significant relationship between enterprise innovation input intensity and enterprise value. Hypothesis 2 is verified.

5 Conclusions

Based on the data of 62 listed companies in the military-civilian integration sector in Shanghai and Shenzhen from 2015 to 2019, this paper empirically studies the relationship between government subsidies, innovation investment intensity and enterprise value. The main conclusions of the empirical analysis are as follows:

A. There is a weak correlation between government subsidies and innovation input intensity, which is significant at the level of 10%. Government subsidies have little positive impact on innovation input intensity. As for government subsidies, relevant enterprises may use this part of the funds for other aspects, and underuse the investment in innovation and R&D.
B. There is a significant negative correlation between government subsidies and enterprise value of military listed companies. The increase of government subsidies reduces the value of enterprises. Relying solely on government subsidies makes military enterprises dependent, which lacks the internal power to enhance enterprise value.
C. Government innovation investment intensity of military listed companies has no obvious correlation with enterprise value. As most military enterprises are state-owned enterprises, they have the characteristics of “big ship is difficult to turn around”, large development inertia and weak ability to adapt to market development, resulting in a negative correlation between government subsidies and enterprise value.

6 Suggestions

Synergetics was proposed by the German physicist HermannHaken in the 1970s. According to the synergy theory, in a complex large system, the synergy behavior of each subsystem produces the single action beyond each element itself, thus forming the unified and joint action of the whole system [10, 11]. Based on this theory, this study puts forward the following suggestions for military enterprises to enhance enterprise value and facilitate the in-depth development of military-civilian integration strategy:

6.1 Motive Force

Military enterprises should establish corporate responsibility to serve national strategy. We should not only adhere to the pursuit of enterprise benefit, but also perfect the internal system incentive, especially the innovation output incentive, improve the output efficiency of innovation input, and enhance the enterprise value with the innovation efficiency.

6.2 External Promotion Layer

The government should play a guiding role of military-civilian integration strategy for enterprises. In accordance with the requirements of the modernization of national defense and the armed forces, targeted subsidies will be given to military enterprises, focusing on cutting-edge technologies and short-board technologies, and the use of funds will be monitored and the effects of subsidies assessed.

6.3 Cultural Layer

In terms of corporate culture, it is necessary to inject corporate value consciousness and social responsibility consciousness, improve corporate culture recognition and sense of belonging, and enrich corporate spirit. At the same time, the system environment and social atmosphere suitable for or conducive to the promotion of military-civilian integration enterprise value should be actively advocated to create a social and cultural environment for the promotion of enterprise value.

References

1. Guellec D, Van Pottelsberghe De La Potterie, B (2003) The impact of public RD expenditureon business R &D. Econ Innov New Technol 12(3):225–243
2. Wu X, Chen Y, Li X, Li Z: Strategic emerging industry RD investment, government subsidy and enterprise value. [4] Hao Fengxia, Zheng Tingting
3. Pan Y, Dai Y, Li C (2009) Political connections and government subsidies for companies in financial distress: empirical evidence from ST companies in China. Nankai Manag Rev 12(05):6–17
4. Ariel P (1985) On patents, RD, and the stock market rate of return 93(2):390–409
5. Hamberg D (1966) RD: essays on the economics of rese arch and development

6. Wu S (2016) Research on the relationship between R & D investment, technological innovation performance and profitability of listed military enterprises. Beijing University of technology
7. Duan J, Bai H, Jin H (2019) An empirical study on the impact of innovation on the efficiency of civil-military integration enterprises: a case study of "ten military industrial groups" listed companies. Sci Technol Manag Res 39(02):55–61
8. Hu E (2011) Fuzzy comprehensive evaluation of water quality based on entropy power method. Sci Technol Inf 16:769–770
9. Li Y, Zhang X (2014) Application of grey relational analysis based on entropy weight in urban sustainable development evaluation. J Univ Chin Acad Sci 31(05):662–670
10. Haken H (1978) Synergetics, pp 52–60. Springer
11. Sun B (2008) Synergetic interpretation of enterprise independent innovation power system. Bus Econ Manag 04:33–37
12. Chen Y (2020) Research on the relationship between government subsidies, technological innovation and firm performance of private enterprises. South China University of Technology
13. Huang XS (2018) Research on the interaction effect of government subsidies, R&D investment and innovation performance of pharmaceutical manufacturing enterprises. Beijing University of Technology
14. Zhang C (2020) The impact of financing structure on enterprise innovation investment. Shandong University
15. Wan K (2019) Financing constraints, financial development and enterprise technological innovation in China. Liaoning University
16. Shao J, Wu S (2018) Managers' military experience and government subsidies–from the dual perspective of charitable donation and redundant employees. J Shanghai Univ Financ Econ 20(03):63–78