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Costing Rule and Cost Behavior in the Korean Defense Industry*

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Abstract

This paper investigates the cost behavior in the Korean defense industry. Managers in the defense industry tend to have motivation to manage earnings because the costs incurring in the production process of defense articles are reimbursed based on cost plus contracts. Results are as follows. First, in the sample of the defense sector, SG&A costs and total manufacturing costs exhibited anti-stickiness whereas labor costs exhibited cost stickiness. Other cost components displayed symmetric cost behavior. Next, in the commercial sector, material costs, direct material costs, total

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manufacturing costs, cost of goods sold, and total costs exhibited anti-stickiness. Labor costs showed cost stickiness whereas SG&A costs, overhead costs, and indirect production costs had symmetric cost behavior. Overall, the results reveals that the change rate of labor costs of the defense sector exhibits more cost stickiness to changes in sales than the commercial sector.

Keywords: cost stickiness, labor costs, defense industry, commercial sector, defense sector

INTRODUCTION

The defense industry, along with the medical industry and the telecommunication industry, is one of the most representatively regulated industries in Korea. The government, as a main customer, has consistently put a great deal of effort into resolving the information asymmetry in cost information and providing a reasonable guideline by which costs are reimbursed. However, prior research has found that the incentive to overstate costs using internal information still exists among defense contractors (Ahn and Heo 2003; Jung et al. 2007; Lichtenberg 1992; McGowan and Vendrzyk 2002; Rogerson 1992; Thomas and Tung 1992).

Considering these aspects, this paper first examines the characteristics of the defense industry from the perspective of the related policies such as defense acquisition program act and regulation on the cost calculation of defense articles, and how this legal system specifies contract methods, cost calculation methods, the Ratios, and profits.

Second, this paper examines whether a manager manipulate costs. In the defense firm, both the defense sector and the commercial sector are operated together, and most of the contracts and cost calculation methods in the defense sector are usually cost plus contracts. Therefore, managers have an incentive to maintain more slack resources in the defense sector than in the commercial sector, and it results in cost-stickiness. Specifically, this study focuses on labor costs among others because for defense articles direct labor costs are used as an cost allocation base and labor costs are also related to compensation. In addition, labor adjustment costs are greater in the defense sector than in the commercial sector because a low level of factory automation in the defense sector require more specialized personnel.

Anecdotal evidence also supports the earnings management of managers in the defense industry. For example, there is an article in the Hankyoreh Newspaper of March 25, 2010 on corruption in defense article costs, titled 'S firm's illegal profits of 9.8 billion won.' The article states that 'an executive of S firm is accused of earning illegal profits of 9.8 billion won while supplying defense articles of 105.5 billion won over three years by manipulating the man hour (labor time) summary sheet, which is used in the calculation of costs.' This constitutes direct evidence that demonstrates the fact that defense contractors have an incentive to overstate their costs, especially their direct labor costs. Because of this tendency of costs to depend on (direct) labor costs, the defense sector of defense companies has a relatively lower incentive to automate its production processes compared with the commercial sector (Ahn and Heo 2003; Rogerson 1992). Therefore, while cost behavior can occur due to many reasons, the defense industry is considered to be a good setting to examine the earnings management.

In sum, it is found that an incentive exists to utilize labor costs strategically to maximize profits among defense companies under the current costs regulations. Next, in analyzing the cost behavior of the defense industry, cost stickiness is observed in the selling, general, and administrative costs (hereafter, SG&A costs), labor costs, direct labor costs, costs of goods sold, and total costs. As regards the defense sector, cost anti-stickiness is observed in the SG&A costs and total manufacturing costs, whereas the labor costs, direct labor costs, and indirect labor costs exhibit cost stickiness. Other cost components show symmetric cost behavior. In the commercial sector, the material costs, direct material costs, total manufacturing costs, costs of goods sold, and total costs display cost anti-stickiness. The labor costs, direct labor costs, and indirect labor costs represent cost stickiness. The SG&A costs, overhead costs, and indirect manufacturing costs reveal symmetric cost behavior. Overall, the results support the prediction that managers will oversate the labor cost in the defense sector.

While prior literature has already investigated this issue, this paper differs from the prior literature in that it uses the cost behavior approach. Following Anderson, Banker, and Janakiraman (2003), many papers reexamine the cost behavior using diverse samples and aim to find the reason of different cost behavior. For example, the research evidence is accumulated through observations of cost behavior in many different cost categories as shown in Anderson and Lanen (2009) and others. This paper is expected to contribute to the management accounting literature by investigating cost behavior of the defense industry, where the data is not easily accessible, and to provide explanation of cost behavior in terms of manager's incentive.

The paper proceeds as follows. In section 2, the characteristics of the Korean defense industry and the regulations regarding contracts and cost calculations are examined. In section 3, the previous literature related to cost behavior is reviewed, and the hypotheses of this study are formulated. In section 4, the sample and the empirical model are proposed, followed by an analysis of the empirical results in section 5. In the last section, the conclusion and limitations of this study are discussed.

COST CALCULATION AND CONTRACT INSTITUTION OF DEFENSE ARTICLES

Characteristics of the Korean Defense Industry

The characteristics of the defense industry as a heavily regulated industry are as follows. First, because the number of suppliers and consumers of defense articles is limited, a perfect competition market cannot exist and the competition is much lower than other industries. Therefore, the prices of defense articles are decided not by the market price but rather by the manufacturing costs (Demski and Magee 1992).

Second, firms that produce defense articles that require complex production processes and a high level of technology are not only sensitive to the government programs that set the level of demand, but are also exposed to a high amount of business risk. Therefore, most defense companies diversify their products and operate both a defense sector and a commercial sector (Demski and Magee 1992; Rogerson 1992; Thomas and Tung 1992). Because the consumers of defense articles are limited to the government, defense companies react sensitively to defense plans in intensifying military strength and future demand plans in order to improve their profitability.

Third, in the process of the development of defense articles, decisions are situated in the conflict between reducing costs and meeting performance standards. For an economic defense operation, cost reduction is required. However, if this reduces the performance of the weapon system or induces failures to meet performance standards, this negative effect will cause substantial and unexpected problems in national security.

Fourth, defense articles are difficult to export overseas. Securing overseas markets for defense articles would stabilize the supply, which in turn would reduce costs and improve profitability for the firm. In addition, it would reduce prices, which in turn would reduce the defense budget of the government.

Cost Calculation and Contract Institution of Defense Articles

The defense sector operates in a significantly different environment from the commercial sector. Instead of conducting research and development to produce products and then selling them to the government, firms receive orders for the research and development or production of defense articles after the government has first created the demand. Also, because of the close relation with national security, security is required in the production process. In addition, other than overseas exports, there are no other consumers for the products.

Because of this operational environment, it is reasonable for the government to designate certain products as defense articles and to designate defense companies, which as a result restricts the market competition. The government therefore has to provide policies and regulations that enable the firms that produce defense articles to recover the invested capital and costs incurred in production and to earn an adequate level of profits. One can see that the actual contract policies and cost calculation methods reflect such issues.

Table 1 shows the defense article contract methods that are used in practice. Contract methods are divided into fixed price contracts and cost plus contracts.

Cost plus contracts put together are double the ratio of firm fixed price contracts, in which the total costs are estimated when the contract is first signed and the amount of the contract is finalized in advance.

The reason that the contracts for defense articles are mostly (about 65.5%) indeterminate contracts (cost plus contracts) is because in the production of defense articles, new developments or specific

Table 1. Contract amount by type

(in 100 million won)

Classification		Amount
Fixed price contracts	Firm fixed price contracts	70,099
	Inflation adjusted price contracts	65
	Fixed price incentive contracts	107
	Sub Total	70,271 (34.5%)
Cost plus contracts	Cost plus proportional fee contracts	23,211
	Midpoint fixed price contracts	74,390
	Fixed price with unsettled cost items contracts	34,917
	Cost plus incentive fee contracts	1,118
	Sub Total	133,636 (65.5%)
Grand Total		203,907 (100%)

Source: Defense Acquisition Program Administration 'Defense electronics procurement system'

standards are frequently required, which makes it difficult to estimate the costs in advance.

Currently, in the procurement of defense articles, most contracts reimburse the costs of the defense companies that occur in production. This can be expected to provide an environment for managers of defense companies in which to adjust the costs in the production process to improve the profitability of the firm.

The related regulations and detailed enforcement regulations are applied in the calculation of the costs of defense articles by distinguishing direct costs and indirect costs, as shown in table 2.

When the indirect manufacturing costs are computed during the calculation of the costs of defense articles, indirect costs are distributed by traditional methods. The distribution criteria of indirect material costs, 'adequate allocation base,' is based on the operating rate (direct labor time, etc.), which is also closely related to the direct labor costs. It implies that direct labor costs information can be a means of manipulating the costs that occur in the production process.

Several examples of the possible methods of manipulating costs that a defense company can utilize are as follows.

The firm can manipulate the amount of labor or labor time that is input to produce defense articles in order to inflate the direct labor

Table 2 Cost calculation of defense articles

Cost category		Detailed category	Calculation method
Manufacturing costs	Direct costs	Direct material costs	Direct trace
		Direct labor costs	
		Direct overhead costs	
	Indirect costs	Indirect material costs	Adequate allocation base (e.g., Machine hours) is applied
		Indirect labor costs	Direct labor costs × indirect labor costs ratio
		Indirect overhead costs	Labor costs × indirect overhead costs ratio
General administrative costs			Manufacturing costs × general administrative costs ratio
Compensation for invested capital			Total costs (manufacturing costs + general administrative costs) × compensation for invested capital ratio
Profits			Basic compensation + risk compensation + effort compensation

costs themselves or to classify what should be indirect labor costs or general administrative costs as direct labor costs in the defense sector. Also, the direct labor costs that occur in the commercial sector can be transferred to the defense sector to overstate the direct labor costs.

Calculation of Ratios and Profits

The current defense article cost calculation policy requires indirect costs, general administrative costs, and profits, to be calculated by multiplying the Ratios of the certain account with the cost criteria, as shown in table 2.

The calculation of the Ratios is conducted by observing the costs that occurred in the production of defense articles in the past two years by firm and by plant, and the ratio of the reflection of the preceding year to the year before that is six to four. For example, the

Table 3. Ratios calculation of defense articles

Ratio category	Calculation method
Indirect labor costs ratio	Indirect labor costs÷direct labor costs
Indirect overhead costs ratio	Indirect overhead costs÷labor costs
General administrative costs ratio	General administrative costs ÷ manufacturing costs
Compensation for invested capital ratio	(Amount of invested capital in defense article production × cost of capital) ÷ total costs
Compensation for facility investment ratio	{Amount of investment in defense article production facility × (equity to total capital ratio × re-investment expenses)} ÷ total costs
Compensation for reduction in costs ratio	Amount of cost reduction ÷ total costs
Compensation for managerial effort ratio	Data on managerial effort for last 2 years
Compensation for export indirect labor costs ratio	Compensation for export indirect labor costs ÷ direct labor costs
Compensation for export general administrative costs ratio	Compensation for export general administrative costs÷manufacturing costs

Ratios for 2011 was prepared and distributed in 2010 and reflects the past figures of 2008 and 2009 with a ratio of 40% and 60%, respectively. That is, if the indirect labor costs ratio for 2008 is 40% and it is 30% for 2009, then the indirect labor costs ratio for 2011 is 34% (= 40% × 0.4 + 30% × 0.6).

Table 3 demonstrates how the Ratios is calculated by firm and by plant. For reference, in practice, when the Ratios is applied, the firms that do not submit the necessary information for the computation of the Ratios receive the lowest ratio for the pertinent year, and the firms that have been newly designated as defense companies receive the average ratio of firms that produce similar defense articles.

According to the cost calculation method of defense articles, if a defense company increases the proportion of direct labor costs in the contract, not only does the direct labor cost increase but also all the other cost components that are affected by direct labor costs increase as well, inducing a larger cost reimbursement. Also, cost components that have increased in the current year are reflected in

Table 4. Profit calculation of defense articles

Category		Calculation method
Basic compensation amount		- Total costs × basic compensation ratio
Risk compensation amount	Technology risk	- Total costs × research and development (1.5%) - First time and follow-up mass production and maintenance (0.75%) - Introduction of technology (0.5%)
	Contract risk	- Total costs × compensation ratio of contract method
Effort compensation amount	Effort in contract execution	- Material costs × 1% - Labor costs × 4% (prototype production 5%, service 9%) - Overhead costs × 3% (service 5%) - Engineering fees × 1% - Amount paid to subcontractor × 1% - Development costs × 8% (service 12%) - General administrative costs × 3% (service 4%)
	Effort in cost reduction	- Total costs × compensation for reduced costs ratio (2% limit)
	Effort in facility investment	- Total costs × compensation for facility investment ratio
	Managerial effort	- Total costs × compensation for managerial effort

the Ratio calculation of the next year and the following year. Therefore, firms have the incentive to focus more on labor costs than on other costs to manage their costs strategically.

As shown in table 4, profits consist of the basic compensation amount, risk compensation amount, and effort compensation amount. Profits are set between an upper limit of {total costs × (16%-average compensation for invested capital ratio of all defense companies)} and a lower limit of {total costs × (9%-firm · plant compensation for invested capital ratio)}. If the profits calculated as are outside the limits, then the value of both extremes is set as the profit to be included in the calculation of the costs.

Although this profit guarantee policy has contributed to the protection of the defense industry and the stable procurement of defense articles, the compensation for the efforts of the firms has been determined to be insufficient, and in order to increase competitiveness the limit policy was repealed in 2012.

Among the components of profits, effort in contract execution is, unlike other components that are calculated to be proportionate to the total costs, calculated as the sum of the proportions of individual manufacturing cost components, enabling the observation of how much labor costs impact on profits.

PRIOR LITERATURE AND HYPOTHESES DEVELOPMENT

Literature on Cost Behavior

Anderson, Banker, and Janakiraman (2003) is the first study to empirically demonstrate asymmetric cost behavior by using revenue information as a proxy for the level of activity. The paper assumes cost stickiness to be the result of the short-term managerial decisions that consider transaction costs and suggests that the factors that influence “cost stickiness” are adjustment costs and agency costs. When revenues decrease for two consecutive years, the degree of cost stickiness decreases, and if firms have a larger proportion of employees and assets that are for supporting sales activities, the adjustment costs of the firm increase which induces more cost stickiness in SG&A costs. Also, if the economy growth rate is high, firms that have decreased sales for the contemporary year have less incentive to decrease inputs, which generates stronger cost stickiness.

Weidenmier and Subramaniam (2003) analyzed cost stickiness with changes in revenue in SG&A costs and cost of goods sold. According to this paper only when revenue changes are over 10% do SG&A costs and costs of goods sold exhibit cost stickiness. This is because when the level of activity decreases by a large amount, adjustment costs and expectations of the recovery of demand deter the manager from decreasing committed resources as fast, which eventually results in cost stickiness. Also, the authors predict that cost behavior will be different across industries and find that manufacturing industry firms exhibit the most cost stickiness.

Balakrishnan, Petersen, and Soderstrom (2004) extend the research of Anderson, Banker, and Janakiraman (2003) by examining physical therapy clinics and analyzing two factors among many that can induce cost stickiness through impacting the manager's decision on the change in activity levels. The factors are the 'magnitude of the change in activity' and 'capacity utilization' measured by available staff hours per patient visits. If capacity is strained or the utilization of resources are high, mangers become more responsive to the change in the level of activity, which strengthens cost stickiness. However under excess capacity, cost behavior turned out to exhibit anti-stickiness.

Banker, Byzalov, and Chen (2013) analyzed the influence of the distinct characteristics of labor markets by country on asymmetric cost behaviors through the cost stickiness of operating costs. The factors that adjust the labor resources in the firm such as bargaining power of labor unions, the concentration and cooperation of collective agreements, the level of unemployment benefits, and the strength of employment protection laws have been empirically proven to influence cost behaviors from a sample of 19 OECD countries.

Calleja, Steliaros, and Thomas (2006) analyze cost stickiness among firms in the United States, United Kingdom, France, and Germany. In all countries, operating costs exhibited cost stickiness with the change in revenues, and this cost stickiness turned out to be stronger in the French and German firms than in U.S. and U.K. firms. The paper conjectures that this is because of different corporate governance systems and the oversights of managers in the decision making process for adjustment of committed resources.

Anderson and Lanen (2009) examine the behavior for various cost categories such as the discretionary components of SG&A costs which are research and development costs and advertising costs, labor costs, expenditures on property, plant, and equipment, and total costs. This paper shows that certain cost categories exhibit symmetric cost behavior or even anti-stickiness. This paper states that the approach in Anderson, Banker, and Janakiraman (2003) does not yield consistent conclusions on managers' decisions and must consider how the manager reacts to changes in the market in order to fully understand costs.

Dierynck, Landsman, and Renders (2012) empirically examine the influence of earnings management on labor costs asymmetry. To meet or beat the benchmark of zero earnings, managers have incentives to increase labor costs less when sales increase and decrease labor costs more when sales decrease. This is more appeared to small-profit firms and is related to employment flexibility.

Ahn, Lee, and Jung (2004) verify the cost stickiness in manufacturing costs with changes in sales. Labor costs and material costs were found to have symmetric cost behavior, total manufacturing costs, and SG&A costs exhibited cost stickiness. The reason material costs had symmetric cost behavior is because direct material costs were a larger proportion of total material costs than indirect material costs. The reason for labor costs is because of the larger proportion of direct labor costs and also because labor time could be adjusted to changes in market demand through overtime.

Ko, Kwon, and Hwang (2009) analyze the relation between a firm's position in the firm life cycle and cost stickiness of SG&A costs. Firms in the growth stage exhibit cost stickiness where sales increase induces a larger increase in costs than the decrease in costs when sales fall. However firms in the decline stage exhibit anti-stickiness where SG&A costs fall more when revenues decrease compared to the increase in costs when revenues increase.

Moon and Hong (2010) analyze the cost behavior of the cost categories of total costs, cost of goods sold, SG&A costs, and discretionary cost. The paper finds that the cost categories that exhibit cost stickiness are different depending on which industry the firm is in. Also in most industries, when the change in sales is over 50%, cost stickiness can be identified clearly.

Ahn, Song, and Jung (2010) find that when there are macroeconomic crises or recessions such as the Asian financial crisis, costs decrease more when sales drop to exhibit anti-stickiness. This paper conjectured that not only should financial crises be considered in cost behavior research but also the overall macroeconomic conditions, such as exchange rates, and the level of inventory should be considered as well.

Literature on the Incentives of Defense Contractors

Reichelstein and Osband (1984) argues that because the defense contractors have the information superiority of costs, the defense contractors have an incentive to distort the costs in order to get a higher compensation.

Rogerson (1992) theoretically proved that there are incentives to shift overhead costs from the commercial contract to the government contract in order to increase the price competitiveness of commercial goods and earn excess earnings in the commercial sector.

Thomas and Tung (1992) provide empirical evidence on cost shifting activity through data on pension costs. The defense contractors have the incentives to shift the pension costs from the non-defense sector to the defense sector where costs are reimbursed.

Lichtenberg (1992) empirically analyzes the profitability of government contractors and non-government contractors, and finds that firms with larger proportions of government contracts in total sales exhibit higher profitability. The government has incentives to enable defense contractors to achieve a profit level higher than the industry average in order to prevent interruptions in the supply of defense articles. Defense contractors, on the other hand, were expected to set the price of defense products and services higher than the market price by exploiting the information advantage due to the difficulty of supervising the quality of defense products and services.

Demski and Magee (1992) consider the cost shifting activity of the defense contractors to be similar to income smoothing driven by manager compensation, and conjecture that defense contractors conduct income smoothing through various decisions in operations and methods of accounting.

Ahn and Heo (2003) emphasize the fact that in the process of calculation of costs and profits for defense articles, the manager has the ability to strategically manage direct labor costs, and because of this defense companies are not inclined to increase the extent of automation in production facilities.

Jung et al. (2007) conduct research under the assumption that heavily regulated industries have the incentive to manage earnings in order to increase the bargaining power against the government to decrease regulations. The paper provides an empirical evidence by using accruals as the means of the manager's discretional earnings management.

Hypotheses Development

In the defense firm, because both the defense sector and the commercial sector are operated together, the managers have an incentive to manage their cost calculation methods and Ratios strategically to increase their earnings under the current contract system, in which the costs of defense articles are reimbursed.

The features that affect the cost behavior of the defense sector are as follows. First, most of the contracts and cost calculation methods in the defense sector are usually cost plus contracts. This provides the managers with incentives to manage manufacturing costs at the production level to increase the earnings and raise the bargaining power with the government. For defense articles the calculation of general administrative costs and indirect costs is proportionate to direct labor costs. In addition, because the allocation of indirect material costs is based on direct labor costs as well, the importance of direct labor costs in the cost calculation of defense articles is substantial.

Second, the Ratios is determined beforehand by firm and plant to calculate indirect costs and general administrative costs. The manager has incentives to manipulate this Ratios to obtain a higher level of compensation from the government. If a defense company increases the proportion of its direct labor costs, then depending on the cost calculation method, the firm will be reimbursed by a larger amount, and the increased cost components of the current year will directly impact on the Ratios of the next year and the year afterwards. In conclusion, the managers of defense contractors have an incentive to manipulate cost components through direct labor costs.

Third, the profit calculation of defense articles consists of three components: the basic compensation amount, risk compensation amount, and effort compensation amount. Unlike other components, which are calculated as a proportion of the total costs, the compensation amount for effort in contract execution is calculated as the sum of the proportions of cost categories. This implies a manager can manipulate the direct and indirect labor costs information to increase the profits of the firm.

In order to obtain a larger amount of reimbursement from the government, defense companies have an incentive to manage their labor costs strategically in the labor-intensive defense sector. In addition, because of the uniqueness of the production process of weapon systems with a low level of factory automation, the defense sector is faced with higher adjustment costs than the commercial sector, which come from the rehiring and laying off of specialized personnel. Therefore, the following hypotheses can be developed regarding the cost behavior of the defense sector and the commercial sector of defense companies.

> **H1a:** The change rate of labor costs will exhibit more cost stickiness to the change in sales in the defense sector than in the commercial sector.
>
> **H1b:** The change rate of direct labor costs will exhibit more cost stickiness to the change in sales in the defense sector than in the commercial sector.
>
> **H1c:** The change rate of indirect labor costs will exhibit more cost stickiness to the change in sales in the defense sector than in the commercial sector.

RESEARCH DESIGN

Sample Selection and Data

The sample of this paper is based on defense companies whose financial statements are available in 'Defense industry management analysis.' The sample period is from 1997 to 2009, which is the period of when reported labor costs have been divided into direct and indirect labor costs. 116 firms are included in the sample period to yield 1,001 firm-year observations.

Because this study focuses on comparing the cost behavior of the defense sector and the commercial sector of defense companies, 102 firm-year observations of firms that only have a defense sector are excluded. Also 36 firm-year observations that have negative values for the variables of commercial sector have been excluded as well. The final sample of this study consists of 863 firm-year observations from 110 firms.

The balance sheet from the 'Defense industry management analysis' consists of data by firm and by defense plant. The income statement and the schedule of cost of goods manufactured data are in the form of the entire firm and the defense sector of the firm. Defense plant is one where defense articles and commercial goods are produced together in the same plant due to common production processes and common facilities. The defense sector is one that produces defense articles.

Table 5. Sample distribution by industry

K-SIC	Industry classification	Number	Ratio
13	Fabric product manufacturing	1	0.9%
17	Pulp, paper and paper product manufacturing	1	0.9%
20	Chemical and chemical product manufacturing	3	2.7%
22	Rubber and plastic product manufacturing	4	3.6%
23	Non-metallic mineral product manufacturing	1	0.9%
24	Primary metal manufacturing	10	9.0%
25	Metal processed product manufacturing	7	6.4%
26	Electronic parts, computers, video, audio, and telecommunication equipment manufacturing	19	17.3%
27	Medical, precise, optical instrument and clock manufacturing	5	4.6%
28	Electrical equipment manufacturing	5	4.6%
29	Other machine and equipment manufacturing	12	10.9%
30	Automobile and trailer manufacturing	23	20.9%
31	Other transportation equipment manufacturing	16	14.6%
33	Other products manufacturing	2	1.8%
58	Publish (development and supply of system software)	1	0.9%
15 industries		110	100%

Because the 'Defense industry management analysis' does not provide any information on the commercial sector, this study sets the variables for the commercial sector as the subtraction of the defense sector variables from the defense company variables.

Most studies on the cost behavior of Korean manufacturing firms have had the limitation of not being able to utilize direct costs and indirect costs information due to the usage of the schedule of cost of goods manufactured as their data. However, in the case of Korean defense contractors, although their schedule of cost of goods manufactured are not opened to the public and can only be read with many limitations, it provides us with direct and indirect cost information, which makes a more detailed analysis possible.

Table 5 shows the industry classification of the final sample, following the Korean standard industry classification (K-SIC).

Research Model

First, we examines the cost behavior of the defense industry based on Ahn, Song, and Jung (2010).

$$\Delta Cost_{i,t} = \alpha_1 + \alpha_2 \cdot D\_NEG_{i,t} + \beta_1 \cdot \Delta Sales_{i,t} + \beta_2 \cdot \Delta Sales_{i,t} \times D\_NEG_{i,t} + \beta_j \cdot \sum ind\_dummy + \beta_k \cdot \sum year\_dummy + \varepsilon_{i,t} \text{ ------------ Eq.(1)}$$

where,

$\Delta Cost_{i,t}$ = $\ln(Cost_{i,t}/Cost_{i,t-1})$, which is the natural log value of the change rate of the cost component [SG&A costs, material costs, direct material costs, indirect material costs, labor costs, direct labor costs, indirect labor costs, overhead costs, indirect manufacturing costs, total manufacturing costs, cost of goods sold, total costs (cost of goods sold + SG&A costs), research and development costs];

$D\_NEG_{i,t}$ = indicator variable that equals 1 if the sales of firm i have decreased in year t compared to t − 1, and 0 otherwise. (1 if $\Delta Sales_{i,t} < 0$, 0 if $\Delta Sales_{i,t} \geqq 0$);

$\Delta Sales_{i,t}$ = $\ln(Sales_{i,t}/Sales_{i,t-1})$, natural log value of change in sales;

$\sum$ind_dummy = industry dummy;

$\sum$year_dummy = year dummy.

In the Eq.(1), β_1 is the coefficient that represents the rate of increase in costs when sales increase, and $(\beta_1 + \beta_2)$ represents the rate of decrease in costs when sales decrease. If the costs component exhibits symmetric cost behavior, the estimated value of β_2 will not be significantly different from 0. However, if the cost behavior is sticky, $\beta_2 < 0$ under the assumption that $\beta_1 > 0$, and this would imply that $(\beta_1 + \beta_2) < \beta_1$. On the other hand, if the cost behavior is anti-sticky, then $\beta_2 > 0$, so $(\beta_1 + \beta_2) > \beta_1$.

Next, we examine whether the cost stickiness is more pronounced in the defense sector than in the commercial sector. The following Eq.(2) is based on Eq.(1) and includes a dummy variable that indicates whether the information is on the defense sector or the commercial sector.

If the coefficient of the interaction term that includes D_DFS, β_4, is negative and statistically significant, this would imply that the behavior of labor costs, direct labor costs, and indirect labor costs would be stickier in the defense sector than in the commercial sector.

$$\Delta Cost_{i,t} = \alpha_1 + \alpha_2 \cdot D\_NEG_{i,t} + \beta_1 \cdot \Delta Sales_{i,t} + \beta_2 \cdot \Delta Sales_{i,t} \times D\_NEG_{i,t} + \beta_3 \cdot \Delta Sales_{i,t} \times D\_DFS + \beta_4 \cdot \Delta Sales_{i,t} \times D\_NEG_{i,t} \times D\_DFS + \beta_j \cdot \sum ind\_dummy + \beta_k \cdot \sum year\_dummy + \varepsilon_{i,t} \text{ ---------- Eq.(2)}$$

where,

$\Delta Cost_{i,t}$ = $\ln(Cost_{i,t}/Cost_{i,t-1})$, which is the natural log value of the change rate of the cost component (labor costs, direct labor costs, indirect labor costs);

D_DFS = indicator variable that is 1 if the observation is of defense sector, 0 otherwise;

Other variables are defined in Eq.(1).

RESULTS

Descriptive Statistics and Correlation Matrix

Table 6 represents the descriptive statistics of the variables that have been included in this study. One interesting point is that the mean value of certain variables in panel C (ΔMT, ΔLB, ΔOH, ΔID_M_C, ΔTMC, ΔRND) are negative. This implies that compared to defense companies and their defense sector, commercial sector costs are on average decreasing for the current year compared to prior years. This can be estimated to be the results of the incentive of defense contractor managers to reduce costs in the commercial sector to maximize profits.

Table 7 is the correlation matrix of the variables that have been included in this study. The relation between the change in sales (ΔSales) and change in cost of goods sold (ΔCOGS), and between change in sales (ΔSales) and change in total costs (ΔTC) is positive and statistically significant at the 1% level. It means that utilizing sales information as a proxy for level of activity is available.

Table 6. Descriptive statistics

Variables	Panel A. Defense companies			Panel B. Defense sector			Panel C. Commercial sector		
	Mean	Std.	Median	Mean	Std.	Median	Mean	Std.	Median
$\Delta SGNA_{i,t}$	0.072	0.335	0.066	0.064	0.766	0.060	0.051	0.762	0.061
$\Delta MT_{i,t}$	0.047	0.433	0.065	0.048	0.618	0.046	-0.018	1.049	0.052
$\Delta D\_MT_{i,t}$	0.051	0.434	0.054	0.067	0.669	0.056	0.072	0.923	0.065
$\Delta ID\_MT_{i,t}$	0.023	0.856	0.033	0.082	0.956	0.044	0.106	1.251	0.072
$\Delta LB_{i,t}$	0.027	0.271	0.049	0.055	0.607	0.056	-0.064	1.043	0.030
$\Delta D\_LB_{i,t}$	0.023	0.437	0.037	0.092	0.664	0.074	0.036	0.941	0.052
$\Delta ID\_LB_{i,t}$	0.014	0.459	0.047	0.075	0.651	0.075	0.010	0.855	0.061
$\Delta OH_{i,t}$	0.031	0.371	0.045	0.054	0.568	0.058	-0.044	1.085	0.041
$\Delta ID\_M\_C_{i,t}$	0.020	0.403	0.038	0.070	0.567	0.075	-0.026	1.151	0.055
$\Delta TMC_{i,t}$	0.038	0.349	0.066	0.054	0.518	0.062	-0.002	0.836	0.058
$\Delta COGS_{i,t}$	0.051	0.278	0.067	0.065	0.764	0.058	0.042	0.657	0.066
$\Delta TC_{i,t}$	0.054	0.268	0.068	0.064	0.739	0.058	0.044	0.651	0.063
$\Delta RND_{i,t}$	0.098	1.142	0.071	0.044	1.161	0.058	-0.067	1.433	0.040
$\Delta Sales_{i,t}$	0.049	0.282	0.074	0.064	0.736	0.065	0.039	0.671	0.077

1) The definition of the variables are as follows;

$\Delta SGNA_{i,t}$ = ln(SG&A costs$_{i,t}$/SG&A costs$_{i,t-1}$);
$\Delta MT_{i,t}$ = ln(material costs$_{i,t}$/material costs$_{i,t-1}$);
$\Delta D\_MT_{i,t}$ = ln(direct material costs$_{i,t}$/direct material costs$_{i,t-1}$);
$\Delta ID\_MT_{i,t}$ = ln(indirect material costs$_{i,t}$/indirect material costs$_{i,t-1}$);
$\Delta LB_{i,t}$ = ln(labor costs$_{i,t}$/labor costs$_{i,t-1}$);
$\Delta D\_LB_{i,t}$ = ln(direct labor costs$_{i,t}$/direct labor costs$_{i,t-1}$);
$\Delta ID\_LB_{i,t}$ = ln(indirect labor costs$_{i,t}$/indirect labor costs$_{i,t-1}$);
$\Delta OH_{i,t}$ = ln(overhead costs$_{i,t}$/overhead costs$_{i,t-1}$);
$\Delta ID\_M\_C_{i,t}$ = ln(indirect manufacturing costs$_{i,t}$/indirect manufacturing costs$_{i,t-1}$);
$\Delta TMC_{i,t}$ = ln(total manufacturing costs$_{i,t}$/total manufacturing costs$_{i,t-1}$);
$\Delta COGS_{i,t}$ = ln(cost of goods sold$_{i,t}$/cost of goods sold$_{i,t-1}$);
$\Delta TC_{i,t}$ = ln(total costs$_{i,t}$/total costs$_{i,t-1}$);
$\Delta RND_{i,t}$ = ln(research and development costs$_{i,t}$/research and development costs$_{i,t-1}$);
$\Delta Sales_{i,t}$ = ln(sales$_{i,t}$/sales$_{i,t-1}$)

Regression Results

Table 8 displays the cost behavior of the Korean defense industry analyzed with Eq.(1). The cost behavior of the defense industry is examined by distinguishing the defense sector and the commercial

Table 7. Correlation matrix (defense companies)

	$\Delta SGNA_{i,t}$	$\Delta MT_{i,t}$	$\Delta D\_MT_{i,t}$	$\Delta ID\_MT_{i,t}$	$\Delta LB_{i,t}$	$\Delta D\_LB_{i,t}$	$\Delta ID\_LB_{i,t}$	$\Delta OH_{i,t}$	$\Delta ID\_M\_C_{i,t}$	$\Delta TMC_{i,t}$	$\Delta COGS_{i,t}$	$\Delta TC_{i,t}$	$\Delta RND_{i,t}$
$\Delta MT_{i,t}$	0.2421 (<.0001)***												
$\Delta D\_MT_{i,t}$	0.1839 (<.0001)***	0.9364 (<.0001)***											
$\Delta ID\_MT_{i,t}$	0.0550 (0.2762)	0.3468 (<.0001)***	0.2667 (<.0001)***										
$\Delta LB_{i,t}$	0.2375 (<.0001)***	0.5152 (<.0001)***	0.4891 (<.0001)***	0.2386 (<.0001)***									
$\Delta D\_LB_{i,t}$	0.1501 (0.0001)***	0.3059 (<.0001)***	0.3861 (<.0001)***	0.2439 (<.0001)***	0.5539 (<.0001)***								
$\Delta ID\_LB_{i,t}$	0.1354 (0.0007)***	0.2881 (<.0001)***	0.4448 (<.0001)***	0.3531 (<.0001)***	0.5531 (<.0001)***	0.0938 (0.0214)**							
$\Delta OH_{i,t}$	0.2522 (<.0001)***	0.5771 (<.0001)***	0.5607 (<.0001)***	0.2717 (<.0001)***	0.5887 (<.0001)***	0.3104 (<.0001)***	0.3422 (<.0001)***						
$\Delta ID\_M\_C_{i,t}$	0.2366 (<.0001)***	0.6318 (<.0001)***	0.5251 (<.0001)***	0.4940 (<.0001)***	0.6520 (<.0001)***	0.2793 (<.0001)***	0.6382 (<.0001)***	0.9157 (<.0001)***					
$\Delta TMC_{i,t}$	0.2737 (<.0001)***	0.9138 (<.0001)***	0.8562 (<.0001)***	0.3328 (<.0001)***	0.6656 (<.0001)***	0.3746 (<.0001)***	0.3934 (<.0001)***	0.7942 (<.0001)***	0.8211 (<.0001)***				
$\Delta COGS_{i,t}$	0.3914 (<.0001)***	0.6677 (<.0001)***	0.6769 (<.0001)***	0.2341 (<.0001)***	0.4809 (<.0001)***	0.2903 (<.0001)***	0.2539 (<.0001)***	0.5708 (<.0001)***	0.5647 (<.0001)***	0.7168 (<.0001)***			
$\Delta TC_{i,t}$	0.5423 (<.0001)***	0.6464 (<.0001)***	0.6383 (<.0001)***	0.2095 (<.0001)***	0.4694 (<.0001)***	0.2913 (<.0001)***	0.2375 (<.0001)***	0.5624 (<.0001)***	0.5455 (<.0001)***	0.6986 (<.0001)***	0.9781 (<.0001)***		
$\Delta RND_{i,t}$	0.1194 (0.0218)**	0.1045 (0.0448)**	0.1156 (0.0721)*	0.1255 (0.0924)*	0.0906 (0.0821)*	0.0823 (0.1215)	0.0420 (0.4470)	0.1584 (0.0023)***	0.1621 (0.0117)**	0.1184 (0.0229)**	0.1423 (0.0062)***	0.1340 (0.0099)***	
$\Delta Sales_{i,t}$	0.3867 (<.0001)***	0.6825 (<.0001)***	0.6935 (<.0001)***	0.2558 (<.0001)***	0.4748 (<.0001)***	0.2987 (<.0001)***	0.2511 (<.0001)***	0.5443 (<.0001)***	0.5471 (<.0001)***	0.7147 (<.0001)***	0.9448 (<.0001)***	0.9218 (<.0001)***	0.1311 (0.0117)**

1) ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed test). The p-values are specified in the parentheses.
2) See table 6 for the definition of the variables.

sector as well. To control for outliers in the sample, all the variables were winsorized for the upper and lower 1%.

In table 8, β_2 is the coefficient for the interaction term between the change in sales (ΔSales) and the dummy variable that equals one if the sales have decreased from the prior year (D_NEG). If β_2 is significantly negative, cost stickiness is observed, whereas if β_2 is positive and significant, anti-stickiness exists for the cost component of interest. However, if the coefficient of β_2 is statistically insignificant, symmetric cost behavior is observed.

In panel A, which examines the sample of defense companies, cost stickiness is observed in the SG&A costs (ΔSGNA), labor costs (ΔLB), direct labor costs (ΔD_LB), cost of goods sold (ΔCOGS), and total costs (ΔTC).

In panel B, in which the sample is the defense sector, the SG&A costs (ΔSGNA) and total manufacturing costs (ΔTMC) exhibit anti-stickiness. The labor costs (ΔLB), direct labor costs (ΔD_LB), and indirect labor costs (ΔID_LB) show cost stickiness. Other cost components exhibit symmetric cost behavior. This is consistent with the fact that the demand and supply of defense articles is not stable year by year. This induces managers to decrease substantially the SG&A costs, which are not directly related to production, when sales decrease, whereas in such a situation the costs of production proportionately increase or decrease with increases and decreases in sales. This implies that the factors of production (material costs and overhead costs) are flexibly adjusted to changes in sales.

In Panel C, in which the sample is the commercial sector. The material costs (ΔMT), direct material costs (ΔD_MT), total manufacturing costs (ΔTMC), cost of goods sold (ΔCOGS), and total costs (ΔTC) exhibit anti-stickiness. The labor costs (ΔLB), direct labor costs (ΔD_LB), and indirect labor costs (ΔID_LB) display cost stickiness, whereas the SG&A costs (ΔSGNA), overhead costs (ΔOH), and indirect manufacturing costs (ΔID_M_C) show symmetric cost behavior.

Especially compared with panel B, the material costs, direct material costs, and cost of goods sold were found to have anti-stickiness, which implies that when sales decrease, the commercial sector of firms has an incentive to attempt to reduce the costs further to increase earnings. Also, the labor costs, direct labor costs, and indirect labor costs exhibit asymmetric cost behavior in both the defense sector (panel B) and the commercial sector (panel C).

Table 8. Regression results of cost behavior analysis

$\Delta Cost_{i,t} = \alpha_1 + \alpha_2 \cdot D\_NEG_{i,t} + \beta_1 \cdot \Delta Sales_{i,t} + \beta_2 \cdot \Delta Sales_{i,t} \times D\_NEG_{i,t} + \beta_j \cdot \sum ind\_dummy + \beta_k \cdot \sum year\_dummy + \varepsilon_{i,t}$

	Exp. Sign	$\Delta SGNA_{i,t}$	$\Delta MT_{i,t}$	$\Delta D\_MT_{i,t}$	$\Delta ID\_MT_{i,t}$	$\Delta LB_{i,t}$	$\Delta D\_LB_{i,t}$	$\Delta ID\_LB_{i,t}$	$\Delta OH_{i,t}$	$\Delta DMC_{i,t}$	$\Delta TMC_{i,t}$	$\Delta COGS_{i,t}$	$\Delta TC_{i,t}$	$\Delta RND_{i,t}$
Panel A. defense companies														
intercept		0.0433 (0.43)	0.0336 (0.32)	0.0221 (0.19)	0.1530 (0.47)	0.0108 (0.14)	0.0488 (0.35)	-0.0676 (-0.47)	-0.0320 (-0.31)	-0.0030 (-0.02)	0.0214 (0.27)	-0.0075 (-0.25)	-0.0046 (-0.14)	-1.7895 (-1.53)
α_2	(?)	0.0338 (0.94)	0.0170 (0.46)	0.0169 (0.39)	0.0438 (0.33)	0.0057 (0.21)	-0.0286 (-0.57)	0.0262 (0.48)	0.0310 (0.86)	0.0260 (0.56)	0.0033 (0.12)	0.0140 (1.33)	0.0160 (1.35)	0.1183 (0.62)
β_1	(+)	0.6219 (6.87)***	1.2069 (12.98)***	1.2037 (11.27)***	0.6872 (2.11)**	0.5094 (7.39)***	0.5442 (4.34)***	0.4558 (3.23)***	0.7552 (8.26)***	0.7005 (6.09)***	0.9647 (13.43)***	1.0186 (38.29)***	0.9763 (32.58)***	0.5855 (1.29)
$\boldsymbol{\beta_2}$	**(-)**	**-0.2298 (-1.76)***	**-0.1994 (-1.55)**	**-0.2284 (-1.58)**	**0.0336 (0.07)**	**-0.1892 (-1.99)****	**-0.3029 (-1.75)***	**-0.1524 (-0.79)**	**-0.0559 (-0.44)**	**0.0571 (0.37)**	**-0.1321 (-1.33)**	**-0.1173 (-3.19)*****	**-0.1353 (-3.27)*****	**-0.0344 (-0.05)**
Adj.R^2		0.1444	0.4626	0.4791	0.0317	0.2481	0.0815	0.0860	0.2932	0.2980	0.5073	0.8935	0.8538	0.0150
Panel B. Defense sector of defense companies														
intercept		0.0130 (0.09)	0.0869 (0.55)	0.0645 (0.31)	-0.0667 (-0.19)	0.2035 (0.61)	0.0634 (0.15)	-0.5273 (-1.27)	0.1301 (0.84)	0.0191 (0.10)	0.1290 (1.03)	-0.0253 (-0.25)	-0.0190 (-0.22)	-1.5246 (-1.24)
α_2	(?)	0.1364 (3.17)***	-0.2524 (-5.33)***	-0.3048 (-4.59)***	-0.1131 (-0.86)	-0.0915 (-2.70)***	-0.1382 (-3.12)***	-0.1112 (-2.41)**	-0.1329 (-2.88)***	-0.1785 (-3.05)***	-0.2028 (-5.40)***	-0.0016 (-0.05)	0.0118 (0.46)	0.2042 (0.91)
β_1	(+)	0.8126 (21.76)***	0.4375 (9.97)***	0.4325 (7.94)***	0.4150 (3.94)***	0.5054 (14.60)***	0.4345 (10.64)***	0.5760 (12.19)***	0.3843 (8.97)***	0.3498 (7.23)***	0.3770 (10.83)***	0.9677 (37.91)***	0.9363 (41.52)***	0.0527 (0.25)
$\boldsymbol{\beta_2}$	**(-)**	**0.1586 (2.72)*****	**0.0572 (0.83)**	**-0.0602 (-0.65)**	**0.0048 (0.02)**	**-0.1374 (-2.28)****	**-0.1268 (-1.79)***	**-0.3977 (-5.47)*****	**0.0812 (1.21)**	**-0.0243 (-0.30)**	**0.1041 (1.90)***	**-0.0192 (-0.48)**	**0.0170 (0.48)**	**0.1779 (0.49)**
Adj.R^2		0.6664	0.3929	0.3387	0.0798	0.4547	0.3290	0.3830	0.3151	0.2674	0.4554	0.8433	0.8693	-0.0243
Panel C. Commercial sector of defense companies														
intercept		0.0084 (0.05)	0.2508 (0.86)	0.3089 (1.07)	0.7851 (1.48)	-0.3450 (-0.76)	0.1092 (0.65)	0.3634 (1.40)	0.0557 (0.18)	-0.2832 (-0.76)	0.1599 (0.75)	0.0521 (0.66)	0.0445 (0.57)	0.3848 (0.59)
α_2	(?)	0.1959 (3.95)***	0.0162 (0.18)	0.0128 (0.13)	0.3434 (1.80)*	0.0518 (1.13)	-0.0627 (-1.12)	0.0499 (0.87)	0.0514 (0.55)	0.1226 (0.95)	-0.0131 (-0.20)	0.0027 (0.11)	0.0272 (1.15)	-0.1098 (-0.35)
β_1	(+)	0.9693 (18.32)***	0.6507 (6.78)***	0.5650 (5.70)***	0.5566 (3.06)***	0.6954 (14.43)***	0.5905 (9.43)***	0.6573 (10.52)***	0.7465 (7.65)***	0.7896 (6.34)***	0.6937 (10.17)***	0.8687 (34.52)***	0.8685 (35.07)***	0.1723 (0.52)
$\boldsymbol{\beta_2}$	**(-)**	**-0.0241 (-0.33)**	**0.4099 (3.08)*****	**0.4188 (2.98)*****	**0.4186 (1.49)**	**-0.1484 (-2.12)****	**-0.1531 (-1.64)***	**-0.1783 (-1.93)***	**0.2081 (1.52)**	**0.2396 (1.35)**	**0.1933 (2.01)****	**0.0732 (2.06)****	**0.0823 (2.36)****	**-0.1424 (-0.33)**
Adj.R^2		0.5826	0.2882	0.3217	0.0730	0.4306	0.3012	0.3230	0.2758	0.2710	0.3977	0.8669	0.8686	-0.0380

1) ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed test). The t-values are specified in the parentheses.
2) model 5, 6, and 7 of panel B and panel C used studentized residuals of 2.2 < R < -2.2 in the analysis.
3) See table 6 for the definition of the variables.

Prior literature has applied material costs and labor costs as proxies for direct material costs and direct labor costs, respectively. Ahn, Lee, and Jung (2004) conjectured that the reason for the symmetric cost behavior of material costs and labor costs is that the proportion of direct material costs and direct labor costs is sufficiently larger than that of indirect material costs and indirect labor costs. This study utilizes direct material costs and direct labor costs information from the schedule of cost of goods manufactured and finds results that support this assertion.

In Panels A, B, and C, the cost behavior of material costs and labor costs are identical to the cost behavior of direct material costs and direct labor costs. Also, an interesting feature is that the SG&A costs (ΔSGNA) exhibit cost stickiness in the defense companies(panel A), but exhibit anti-stickiness in the defense sector(panel B), and symmetric cost behavior in the commercial sector(panel C).

This is because among the components of general administrative costs in the defense sector, several components are non-costs and will exhibit anti-stickiness when sales decrease. Non-cost components are, as defined in regulation and detailed enforcement regulation on the cost calculation of defense articles, costs that are not directly related to the production and procurement of defense articles. Additionally, these non-cost components that are not acknowledged as costs in the defense sector will be transferred to the commercial sector, which will induce the commercial sector to decrease relatively less when sales decrease.

The hypotheses on the influence of the characteristics of the Korean defense industry on the cost behavior of the defense sector and the commercial sector of defense companies have been tested based on labor costs.

As described above, labor costs information from the defense sector is likely to be managed in order to maximize profitability by increasing cost reimbursements and profit rates. Especially, in the calculations of costs, Ratios, and profit rates, an increase in direct labor costs causes other cost components to increase as well, which provides the manager with incentives to manage the direct labor costs strategically.

Table 9 tabulates the regression results of testing hypotheses by setting labor costs as the dependent variable and comparing cost behavior between the defense sector and the commercial sector.

In order to test the hypotheses, the indicator variable of the de-

Table 9. Comparison of cost behavior between defense and commercial sector

$$\Delta Cost_{i,t} = \alpha_1 + \alpha_2 \cdot D\_NEG_{i,t} + \beta_1 \cdot \Delta Sales_{i,t} + \beta_2 \cdot \Delta Sales_{i,t} \times D\_NEG_{i,t} + \beta_3 \cdot \Delta Sales_{i,t} \times D\_DFS + \beta_4 \cdot \Delta Sales_{i,t} \times D\_NEG_{i,t} \times D\_DFS + \beta_j \cdot \sum ind\_dummy + \beta_k \cdot \sum year\_dummy + \varepsilon_{i,t}$$

	Exp. Sign	$\Delta LB_{i,t}$	$\Delta D\_LB_{i,t}$	$\Delta ID\_LB_{i,t}$
intercept		-0.1260 (-0.52)	0.1561 (1.39)	0.2728 (2.12)**
α_2	?	0.0078 (0.32)	-0.0662 (-1.85)*	-0.0089 (-0.24)
β_1	(+)	0.6741 (19.19)***	0.4763 (9.21)***	0.5599 (10.97)***
β_2	(-)	-0.1246 (-2.35)**	0.0976 (1.18)	-0.0759 (-0.97)
β_3	?	-0.0327 (-0.75)	0.0332 (0.55)	0.1424 (2.29)**
$\boldsymbol{\beta_4}$	**(-)**	**-0.1398** **(-2.10)****	**-0.1561** **(-1.64)***	**-0.4266** **(-4.48)*****
n		1,295	1,087	1,018
Adj.R^2		0.5055	0.3353	0.3409

1) ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed tests). The t-values are specified in the parentheses.
2) Model 1, 2, and 3 of panel A used studentized residuals of 2.2<R<-2.2 in the analysis.
3) See table 6 for the definition of variables.

fense sector (D_DFS) is multiplied with the original interaction term to yield another interaction term ($\Delta Sales_{i,t} \times D\_NEG_{i,t} \times D\_DFS$), which will be the variable of interest.

The coefficients of the interaction terms of interest, β_4 are all negative and statistically significant. This implies that the change rate of labor costs of the defense sector exhibits more cost stickiness than that of the commercial sector. In other words, even if the sales of the defense sector decrease, the labor costs will be reduced relatively less in order to maximize the costs reimbursement from the government.

Also, because of the uniqueness of the production process of weapon systems and the labor-intense structure with a low level of facility automation, the defense sector is confronted with higher adjustment costs than the commercial sector, which come from the employment and dismissal of specialized employees.

CONCLUSION

This paper examines the cost behavior of Korean defense companies and how this is influenced by the characteristics of the defense industry such as the contract policies and cost calculation.

Korean defense firms usually consist of the defense sector, and the commercial sector, and there are substantial differences between the managerial environments of the two sectors. Because the availability of defense articles is restricted, and the consumer is restricted to the government, defense contractors operate on the assumption that the government will reimburse all costs occurring during the production of defense articles.

Under this situation, the decision-making of managing only direct labor costs would increase other costs components that are directly and indirectly connected to direct labor costs, leading to maximizing the cost reimbursement. This is the reason that the manager of defense contractors is motivated to access direct labor costs from the strategic perspective.

This study has the following contributions. First, the paper investigates the incentives of the managers of defense contractors to strategically manage the costs (labor costs) in order to maximize profits. Second, this paper supplements the limitations of prior literature by utilizing the costs information from the schedule of cost of goods manufactured which makes a distinction between direct costs and indirect costs, the limitation of using labor costs as a proxy of direct labor costs have been overcome. Third, by dividing the samples into the defense sector and the commercial sector in the same firm. This attempt is meaningful in that it is related to a characteristic of a certain industry that has not been examined in prior research.

Our study has the following limitations which require caution in interpreting the results. This study is based on 'Defense industry management analysis' data. This information is however limitedly accessed by most researchers, and is not audited. Therefore, it is possible that the manager's discretion is reflected in data. However, this data is also monitored by the dispatched supervisors and used in the preparation of 'Statistical yearbook' that is published by the regulator of Korean defense contractors, which provides credibility and reliability to the data, with certain limitation. In addition, there are limitations on the data regarding the separation of the defense sector and the commercial sector, such as common assets that cannot be determined realistically. For this reason, there is also the plausibility that the evidence provided in this paper may be insufficient to fully support the conjectures of this paper. This issue is left to future research. Despite such shortcomings, it is expected that this study will contribute to the relevant research field by analyzing the cost behavior of the Korean defense industry whose data are not readily accessible to most researchers.

REFERENCES

Ahn, T. S. and E. J. Heo (2003), "Costing and pricing rules and their impact on the incentives of defense contractors," *Korean Accounting Journal*, 12(2), 35-59. [in Korean]

Ahn, T. S., S. Y. Lee, and H. R. Jung (2004), "Asymmetrical behavior of manufacturing costs: Korean evidence," *Korean Management Review*, 33(3), 789-807. [in Korean]

Ahn, T. S., S. A. Song, and H. R. Jung (2010), "Cost stickiness in Korean manufacturing firms revisited," *Korean Accounting Journal*, 19(1), 253-280. [in Korean]

Anderson, M. C., R. D. Banker, and S. N. Janakiraman (2003), "Are selling, general and administrative costs "sticky"?," *Journal of Accounting Research*, 41, 47-63. [in Korean]

Anderson, S. W. and W. N. Lanen (2009), "Understanding cost management: what can we learn from the empirical evidence on 'sticky costs'?," Working paper, Rice University.

Balakrishnan, R., M. J. Petersen, and N. S. Soderstrom (2004), "Does capacity utilization affect the "stickiness" of cost?," *Journal of Accounting, Auditing & Finance*, 19(3), 283-299.

Banker, R. D., D. Byzalov, and L. T. Chen (2013), "Employment protection legislation, adjustment costs and cross-country differences in cost stickiness," *Journal of Accounting and Economics,* 55(1), 111-127.

Calleja, K., M. Steliaros, and D. C. Thomas (2006), "A note on cost stickiness: some international comparisons," Management Accounting Research, 17(2), 127-140.

Demski, J. S. and R. P. Magee (1992), "A perspective on accounting for defense contracts," *The Accounting Review*, 67(4), 732-740.

Dierynck, B., W. R. Landsman, and A. Renders (2012), "Do managerial incentives drive cost behavior? Evidence about the role of the zero earnings benchmark for labor cost behavior in private Belgian firms," *The Accounting Review*, 87(4), 1219-1246.

Jung, H. R., W. J. Lee, S. M. Yoon, and T. S. Ahn (2007), "Does Korean defense industry manage earnings?," *Korean Accounting Review*, 32(1), 59-88. [in Korean]

Ko, Y. W., S. Y. Kwon, and M. H. Hwang (2009), "The effect of firm life-cycle stages on asymmetric behavior of selling, general and administrative costs," *Accounting and Auditing Research*, 49, 283-312. [in Korean]

Lichtenberg, F. R. (1992), "A perspective on accounting for defense contracts," *The Accounting Review*, 67(4), 741-752.

McGowan, A. S. and V. P. Vendrzyk (2002), "The relation between cost shifting and segment profitability in the defense-contracting industry," *The Accounting Review*, 77(4), 949-969.

Moon, H. E. and C. K. Hong (2010), "A comprehensive analysis of asymmetric cost behavior and its inter-industry differences," *Korean Journal of Management Accounting Research*, 10(1), 1-38. [in Korean]

Reichelstein, S. and K. Osband (1984), "Incentives in government contracts," *Journal of Public Economics*, 24(2), 257-270.

Rogerson, W. P. (1992), "Overhead allocation and incentives for cost minimization in defense procurement," *The Accounting Review*, 67(4), 671-690.

Weidenmier, M. L. and C. Subramaniam (2003), "Additional evidence on the sticky behavior of costs," Working paper, Texas Christian University.

Thomas, J. K. and S. Tung (1992), "Cost manipulation incentives under cost reimbursement: pension costs for defense contracts," *The Accounting Review*, 67(4), 691-711.

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