International Journal of Applied Engineering Research
ISSN 0973-4562 Volume 10, Number 12 (2015) pp. 31163-31174

http://www.ripublication.com

The Effects of Rebate Regulation on Cost Behavior inthe Korean Pharmaceutical Industry: Focusing on Cost Stickiness

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ABSTRACT

This study analyzes the effect of the pharmaceutical rebate regulation on the cost of goods sold by pharmaceutical companies. This policy, which was adopted in November 2010, bans the payment or reception of rebate. Such prohibition affects the cost of goods sold or being sold, as well as the general administrative expenses for a pharmaceutical company, which may affect the cost stickiness of the goods sold. Results are detailed below. First, cost stickiness in the cost of goods sold similar to the manufacturing industry was observed. This result indicates minimal cost-saving behavior taken such as decreasing marketing expenses or laying off employees even when sales drop. Second, pharmaceutical rebate regulation appeared to ease cost stickiness for pharmaceutical companies. This result means that when sales decrease, companies reduced their marketing or labor expenses, which reduced the rebate of pharmaceutical companies. Therefore, rebate regulation is deemed effective in regulating the rebate payments of pharmaceutical firms. This study offers policy implications on the implementation of pharmaceutical rebate regulation by government authorities.

Key-words: pharmaceutical rebate regulation, cost stickiness, cost behavior, rebate

Ⅰ. Introduction

In November, 2010, Korea adopted the Pharmaceutical Rebate Regulation system, rendering illegal pharmaceutical firms offering rebates to promote sales or for doctors and medical institutions to receive such rebates. Prior to this rebate regulation, rebates were treated as cost of goods sold (COGS) or selling and general administrative expenses (SG&A) However, when these were banned or limited, the cost behavior of pharmaceutical firms was affected as well.

Regular manufacturing industries show cost stickiness in their COGS (Noreen 1991; Noreen and Soderstrom 1994; Cooper and Kaplan 1992; Noreen and Soderstrom 1997). This cost stickiness means that the decrease in COGS when sales decrease is relatively small, which is referred to as cost asymmetry (Anderson et al. 2007). As a result, the manager manipulates costs or expenses because of government regulation or the manager's opportunistic incentive, which results in cost asymmetry. For example, to minimize the drop in net income resulting from a drop in revenue, an incentive to minimize costs as much as possible may be available. Therefore, the purpose of this study is to analyze the effect of Pharmaceutical Rebate Regulation on the cost behavior of pharmaceutical firms. To that end, 1) pharmaceutical firms are analyzed to determine their a sticky cost structure similar to that of manufacturing companies, 2) and the effect of the adoption of rebate regulation on such cost behavior is analyzed.

Using Korean pharmaceutical firms from 2008 to 2013 as samples, a model on the revised methodology by Anderson et al. (2007) was designed and used for analysis.

Findings present an analysis on the effect of pharmaceutical rebate regulation, which became a popular issue in the Korean pharmaceutical industry. Furthermore, results provide policy implications to the government.

Chapter 2 reviews the rebate regulation for pharmaceutical firms in addition to the related literature used to develop a hypothesis. Chapter 3 describes how the study model and sample are selected. Chapter 4 presents the descriptive statistics, Pearson correlation, and hypothesis test results. Chapter 5 summarizes the findings.

Ⅱ. Rebate Regulation in the Korean Pharmaceutical Industry and Hypothesis

2.1 Pharmaceutical Rebate Regulation in Korea

The dual punishment system for Pharmaceutical Rebate in Korea punishes both the giver (pharmaceutical firms) of rebates, which come in the form of money, goods, benefits, labor, or entertainment, and the receiver (hospitals, doctors, or pharmacists). This regulation was adopted in November 2010. Prior to this policy adoption, when pharmaceutical firms offered economic benefits to doctors or pharmacists to promote their products, only the pharmaceutical firm was punished. Such punishment included imprisonment, fines, or suspension of operations. This resulted in medical institutions using their superior position to request and receive rebates from pharmaceutical companies, as well as in pharmaceutical firms seeking profit via unfair promotional

tactics rather than investing in R&D or quality. Regulations on illegal rebates generally punish the provider and the recipient, yet consider the likelihood that the recipient will be criticized more given their status and obligation for fair conduct, such that the recipient is punished more harshly. As a result, a national consensus has been reached, indicating that a dual punishment system needs to be adopted to prevent the worsening finances of medical insurance and to promote public health was reached. With the dual punishment system, pharmaceutical firms offering rebates, as well as medical institutions, doctors, and pharmacists are subject to legal punishment, leading to the gradual decrease in overall pharmaceutical rebates. A similar example can be found in the US, where the federal anti-kickback statute bans any medical services either partially or entirely funded by the federal health care program, from offering or receiving economic benefits in return for referring patients, or purchasing or leasing goods, facilities, or services. Meanwhile in Japan, no rebate regulation in acts is available for doctors or pharmacists. However, doctors working for a medical institution, by principle, cannot be legally punished for rebates. The clause on bribes in the criminal law is applied to doctors at public medical institutions in such a case.

In the pharmaceutical rebate regulation in Korea, rebates of exceptional cases are not subject to punishment. Medical professionals who received economic benefits or goods are not necessarily immune from punishment. Based on the operation rules for the dual punishment system in rebate regulation, the following are permitted:

① Offering of samples: A minimum quantity of medical devices or products that are marked ‘sample’,

② Sponsorship for academic conferences: Accommodation, meals, transportation, and registration fees for presenters, panels, and participants of academic conferences,

③ Support for clinical trials: Medical products, devices, and R&D expenses necessary for clinical trials,

④ Product information sessions: Refreshments worth less than KRW 100,000, souvenirs worth less than KRW 50,000, actual transportation, accommodation costs, refreshments worth less than KRW 100,000 per day when medical institutions are visited (limited to four times per month), promotion materials worth less than KRW 10,000.

⑤ Discounts based on payment terms: The following discounts when medical institutions pay for medical products or devices (1 month: less than 1.8% of transaction amount, 2 months: less than 1.2%, 3 months: less than 0.6%).

⑥ Research after sales: Post-sales research as approved by the FDA will be compensated with less than KRW 50,000 per case (less than KRW 300,000 if additional research is required).

⑦ Credit card points: Less than 1% of the transaction amount as credit card points if paid using credit cards.

With this Pharmaceutical Rebate Regulation in Korea and exceptions to punishment, the cost behavior of pharmaceutical firms can be affected as well. Before this regulation, rebates were included in the COGS for drugs and were probably elastic in accordance to sales growth. However, such elasticity may have been affected after the regulation. As such, this study seeks to analyze how the Pharmaceutical Rebate Regulation in Korea changed the cost behaviors of pharmaceutical firms.

2.2 Hypothesis Development

Cost accounting generally refers to changes in cost within a relevant range is proportionate to the changes in volume or activities, which was assumed constant regardless of any decrease or increase in activity (Noreen 1991 ; Noreen and Soderstrom 1994). Thus, the degree of costs increase and decrease when sales increase or decrease is the same. However, recent studies show reducing the cost when activities decrease is more difficult because cost and profit are affected by managerial behavior, which leads to asymmetric cost behavior (Cooper and Kaplan 1992 ; Noreen and Soderstrom 1997). Based on these findings, Anderson et al. (2003) verified that changes in SG&A in the overall US business were sticky. An analysis of 7629 companies over the last 2 decades, from 1979 to 1998, showed that when sales grew by 1%, SG&A grew by an average of 0.55%, whereas when sales dropped by 1%, only a 0.35% decrease in SG&A was observed. Different responses by the manager was identified as the major cause for such asymmetry. That is, when sales grow and exceeds production capacity, they immediately increase committed resources, yet when sales drop and a decision has to be made to cut slack resources, they must consider derivative costs related to adjustments. This condition renders cost-reduction decision-making challenging. Anderson and Lanen (2007) argued that the focus should be on analyzing the cause of cost stickiness, and that to efficiently manage costs, managers need to consider how the product market responds to external changes in the market and external changes in the production factors. Furthermore, they confirmed that detailed items of SG&A, such as advertising and promotion expenses, labor costs, and R&D costs failed to exhibit cost stickiness.

The model by Ahn et al. (2004) and Anderson et al. (2003) was used to analyze the cost behavior of Korean manufacturing firms for their COGS and SG&A expenses. Expense accounts showed cost stickiness, whereas the cost of raw ingredients sand labor demonstrated symmetrical cost behavior. They explained that the share of committed cost such as depreciation is large, whereas the cost for raw ingredients or labor is made up mostly by variable cost for SG&A and general expenses. Moreover, Ahn et al. (2006) took into account changes in managerial environments owing to the financial crisis. Therefore, they analyzed the cost behaviors for labor, dividends, and depreciation and found that cost stickiness was only significant after the financial crisis.

Song et al. (2010) reviewed preceding studies on the cost behavior of Korean manufacturing firms and argued that inventory should be controlled when analyzing manufacturing cost behavior. Once inventory is controlled, raw ingredient and manufacturing costs exhibited decreased cost behavior stickiness, which affirms the

need to control inventory. In addition, cost stickiness is found in raw ingredient and manufacturing costs during the financial crisis, which demonstrated aggressive cost-cutting measures among corporations in worsened situations.

Koo et al. (2009) analyzed whether a different cost behavior and cost strategy was observed for different changes in sales. They argued that corporations that saw consistent drops in sales or consistent losses indicated cost stickiness for SG&A and labor. Similarly, Jang and Baik (2009) investigated the effects of managerial conditions on cost-related decision-making. SG&A showed increased stickiness as a higher debt ratio or lower growth rate showed upward cost asymmetry given that given that the larger the share of cash flow in net income, the higher the liquidity ratio and growth.

Lee and Han (2005) reviewed the changes in the cost of goods sold in accordance with the changes in sales by dividing firms with professional managers and are family-owned. Family-owned firms showed downward cost stickiness. On the other hand, professionally managed corporations showed upward cost stickiness. This means that professional managers are more risk-averse and are more interested in short-term profits. Therefore, they are more proactive in their cost-cutting decisions. By combining their reviews on preceding studies, they concluded that cost asymmetry occurs because cost is not in directly proportional to the increase or decrease of activities that are caused by economic or behavioral reasons. The main focus was on identifying the cost for such asymmetry. Pharmaceutical firms are also manufacturing firms and were hypothesized to show similar cost stickiness in this study. As such, the following hypothesis was developed:

Hypothesis 1. Pharmaceutical firms incur cost stickiness.

Cost stickiness will be analyzed for two periods, before and after the adoption of the Pharmaceutical Rebate Regulation in Korea. Before the policy was adopted, the rebates that are offered by pharmaceutical firms to medical institutions was included in the costs of the goods that are sold. However, after the adoption of the regulation, rebates were only included in costs in exceptional cases or not included at all in general.

This will possibly lead to a change in the relationship between sales and costs. Changes in cost behavior that are brought by the policy may be analyzed to evaluate whether the Pharmaceutical Rebate Regulation is effective in its purpose. If the cost behavior has become more elastic and its cost stickiness is mitigated, then the regulation can be seen to have caused a decrease in rebates. With the new regulation, promotion through rebates is not as effective as it used to be and thus pharmaceutical firms cut marketing costs or layoff related personnel. Therefore, the pharmaceutical Rebate Regulation is expected to mitigate the cost stickiness. Thus, the following research hypothesis was developed:

Hypothesis 2. Pharmaceutical Rebate Regulation mitigates cost stickiness of pharmaceutical firms.

Ⅲ. Research Design

3.1 Research Model

In order to analyze the effects of the Pharmaceutical Rebate Regulation in Korea on the cost behavior of pharmaceutical firms, the model in equation (1) was designed. Equation (1) is a revision of the regression model by Anderson et al. (2007) that added in the variable of Regulation (i.e., pharmaceutical rebate regulation in Korea).

Dependent variables are *Δln_Cost, Δln_COGS* and *Δln_SG&A*. This can be measured respectively by the change of the logarithm of total costs, costs of goods sold (COGS) or selling, general, and administrative costs (*SG&A*). Interest variables are *D*×*Δln Sales* and *Regulation*×*D*×*Δln Sales*. These were treated as dummy variables (*D* and *Regulation*) and are measured by the interaction of *Δln_Sales* (the change of the logarithm of sales). *D* is defined as 1 if sales of year t is smaller than that of year t-1, and is considered 0 otherwise. Regulation was given a value of 1 if year t is after adoption of pharmaceutical rebate regulation, and a value of 0 otherwise.

β_2 represents the degree of decrease in cost in accordance with the decrease in sales and thus shows cost asymmetry. If β_2 has a negative sign (-), it indicates cost stickiness existing, supporting hypothesis 1.

β_3 represents the changes in cost behavior of pharmaceutical firms after the adoption of the Pharmaceutical Rebate Regulation in Korea. If β_3 has a negative sign, it indicates a reinforced cost stickiness. Meanwhile, if β_3 has a positive sign, it represents the downward cost stickiness that are being mitigated or cost behavior that are becoming more elastic after the adoption of the Pharmaceutical Rebate Regulation, a result that supports hypothesis 2.

$$\Delta ln\_Cost_{i,t}(or\ \Delta ln\_COGS_{i,t},\ \Delta ln\_SG\&A_{i,t}) = \alpha_0 + \beta_1 \Delta ln\_Sales_{i,t} + \beta_2\, D_{i,t} \times \Delta ln\_Sales_{i,t} + \beta_3\, Regulation_{i,t} \times D_{i,t} \times \Delta ln\_Sales_{i,t} + \beta_4\, D_{i,t} + \beta_5\, Regulation_{i,t} + \beta_6\, BIG4_{i,t} + \beta_7\, OPN_{i,t} + \beta_8\, SIZE_{i,t} + \beta_9\, LEV_{i,t} + \beta_{10}\, ROA_{i,t} + \beta_{11}\, CFO_{i,t} + \beta_{12}\, \Sigma YD_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where in,

$\Delta ln\_Cost_{i,t}$ = the change of the logarithm of costs of goods sold (COGS) and selling, general, and administrative costs (SG&A)

$\Delta ln\_COGS_{i,t}$ = the change of the logarithm of costs of goods sold (COGS)

$\Delta ln\_SG\&A_{i,t}$ = the change of the logarithm of selling, general, and administrative costs (SG&A)

$\Delta ln\ Sales_{i,t}$ = the change of the logarithm of sales (revenue)

$D_{i,t}$ = 1 if sales of year t is smaller than that of year t-1, 0 otherwise

$Regulation_{i,t}$ = 1 if year t is after adoption of pharmaceutical rebate regulation,0 otherwise

$BIG4_{i,t}$ = 1 if external auditor is alliance with Big4, 0 otherwise

$OPN_{i,t}$ = 1 if opinion of external auditor is "qualified", 0 otherwise

$SIZE_{i,t}$ = the logarithm of total assets

$LEV_{i,t}$ = leverage (=total liabilities/total assets)

$ROA_{i,t}$ = return on assets (=net income/total assets)

$CFO_{i,t}$ = cash flow from operating activities/total assets

$\Sigma YD_{i,t}$ = year dummy variables

As control variables, BIG4 is equal to 1 if the external auditor is in alliance with Big4 and 0 otherwise. Furthermore, OPN is defined as 1 if opinion of external auditor is "qualified", and 0 otherwise. SIZE represents the logarithm of total assets and is a variable to control for the corporate size as in Anderson et al. (2007). LEV represents leverage and ROA stands for return on assets. CFO refers to the firm's cash flow from operating activities and ΣYD was added to control for factors that may not be controllable with control variables.

3.2 Sample Selection

Samples were selected among pharmaceutical firms that meet the following criteria from 2008 to 2013 from the KIS-VALE Data base for manufacturing industries.

(1) Firms that have not experienced impairment of capital or receivership
(2) Firms that were not established or shut down from 2008 to 2013

A total of 90 listed firms (38 firms on KOSPI and 52 firms on KOSDAQ) and 132 non-listed firms fit the above criteria that represents a total of 1,332 firm-years.

Ⅳ. Empirical Results

4.1 Descriptive Statistics

Table 1 shows the statistics of major variables used in this study. *Δln_Cost ranges from* -3.1 to 2.874 with an average of 0.104. *Δln_COGS*and*Δln_SG&A* shows a similar normal distribution. *Δln_Sales* ranges from -6.4 to 3.603 with an average of 0.098. This result indicates that the distribution of cost and sales are similar.

D (sales decrease) is an average 0.259 (345 firm-years), while *Regulation* (after adoption of pharmaceutical rebate regulation) is an average 0.5 (666 firm-years).

Table 1. Descriptive Statistics of Major Variables (N=1,332 firm-years)

	Mean	Std.	Min	Q1	Median	Q3	Max
Δln_Cost	0.104	0.277	-3.100	0	0.092	0.189	2.874
Δln_COGS	0.109	0.44	-5.894	0.001	0.098	0.207	6.786
Δln_SG&A	0.086	0.342	-4.726	-0.024	0.071	0.193	2.683
Δln_Sales	0.098	0.416	-6.400	-0.007	0.084	0.190	3.603
D	0.259	0.438	0	0	0	1	1
Regulation	0.50	0.5	0	0	0.5	1	1
BIG4	0.296	0.457	0	0	0	1	1

OPN	0.943	0.232	0	1	1	1	1
SIZE	24.551	1.169	21.317	23.663	24.406	25.412	27.986
LEV	0.466	0.271	0.009	0.268	0.43	0.618	2.479
ROA	0.032	0.155	-1.347	0.009	0.038	0.086	2.842
CFO	0.046	0.104	-0.639	-0.002	0.05	0.101	0.563

Note 1) Variable definitions are as follows:

$\Delta ln\_Cost_{i,t}$ = *the change of the logarithm of costs of goods sold (COGS) and selling, general, and administrative costs (SG&A)*

$\Delta ln\_COGS_{i,t}$ = *the change of the logarithm of costs of goods sold (COGS)*

$\Delta ln\_SG\&A_{i,t}$ = *the change of the logarithm of selling, general, and administrative costs (SG&A)*

$\Delta ln\_Sales_{i,t}$ = *the change of the logarithm of sales (revenue)*

$D_{i,t}$ = *1 if sales of year t is smaller than that of year t-1, 0 otherwise*
$Regulation_{i,t}$ = *1 if year t is after adoption of pharmaceutical rebate regulation,0 otherwise*
$BIG4_{i,t}$ = *1 if external auditor is alliance with Big4, 0 otherwise*
$OPN_{i,t}$ = *1 if opinion of external auditor is "qualified", 0 otherwise*
$SIZE_{i,t}$ = *the logarithm of total assets*
$LEV_{i,t}$ = *leverage (=total liabilities/total assets)*
$ROA_{i,t}$ = *return on assets (=net income/total assets)*
$CFO_{i,t}$ = *cash flow from operating activities/total assets*

4.2 Correlation

Table 2 shows the Pearson correlation between major variables. In the relationship with *Δln Cost*, *Δln COGS* and *Δln SG&A* have a positive correlation at a statistically significant level. With *Δln_Sales*, a statistically significant positive correlation was observed.

However, in the relationship with Regulation, *Δln COGS*, *Δln SG&A,* and *Δln Sales* show a negative correlation that indicates that since the adoption of pharmaceutical rebate regulation, sales and cost are decreased. This finding can be interpreted as the adoption of pharmaceutical rebate regulation that negatively impacts the sales of pharmaceutical firms. Compared to Regulation and *Δln COGS*, a higher correlation with *Δln_SG&A* occurred, which indirectly shows that the rebate regulation led to a drop in rebates or selling expenses.

Table 2. Correlation of Major Variables

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
(1)Δln_ Cost	1										
(2)Δln_ COGS	0.650*** (0.000)	1									
(3)Δln_ SG&A	0.803*** (0.000)	0.353*** (0.000)	1								
(4)Δln_ Sales	0.737*** (0.000)	0.785*** (0.000)	0.607*** (0.000)	1							
(5)D	-0.430*** (0.000)	-0.358*** (0.000)	-0.302*** (0.000)	-0.442*** (0.000)	1						

(6)Reg-ulation	-0.210*** (0.000)	-0.154*** (0.000)	-0.185*** (0.000)	-0.162*** (0.000)	0.221*** (0.000)	1					
(7)BIG4	0.065** (0.024)	0.071** (0.013)	-0.001 (0.976)	0.015 (0.591)	-0.063** (0.027)	-0.154*** (0.000)	1				
(8)OPN	-0.065** (0.023)	0.051* (0.074)	-0.096*** (0.001)	-0.061** (0.033)	0.041 (0.147)	0.054* (0.057)	0.106*** (0.000)	1			
(9)SIZE	-0.090*** (0.001)	-0.056** (0.045)	-0.095*** (0.001)	-0.103*** (0.000)	0.013 (0.642)	0.127*** (0.000)	0.359*** (0.000)	0.281*** (0.000)	1		
(10)LEV	-0.033 (0.242)	-0.031 (0.261)	-0.005 (0.861)	0.019 (0.502)	0.030 (0.272)	-0.009 (0.757)	-0.158*** (0.000)	-0.352*** (0.000)	-0.342*** (0.000)	1	
(11)ROA	0.070** (0.011)	0.115*** (0.000)	-0.011 (0.685)	0.175*** (0.000)	-0.217*** (0.000)	-0.017 (0.541)	0.094*** (0.001)	0.089*** (0.002)	0.099*** (0.000)	-0.398*** (0.000)	1
(12)CFO	-0.003 (0.924)	0.073** (0.010)	-0.064** (0.024)	0.053* (0.064)	-0.078*** (0.006)	0.032 (0.261)	0.087*** (0.003)	0.094*** (0.001)	0.095*** (0.001)	-0.335*** (0.000)	0.530*** (0.000)

*Note 1) *, **, *** denote significance at 10%, 5%, 1% level based on two tailed test*
Note 2) Variable definitions are as note 1) of table 1

4.3 Multivariate Analysis

Table 3 shows the OLS regression between changes in *Cost, COGS* and *SG&A* and interest variables. All variables have a VIF value of less than 4, which indicates no issues with multicollinearity. F-statistics are statistically significant 66−168 and shows no issues with the fitness of model, either. The adjusted R^2 ranges from 44.6% to 67.57%.

Table 3. Regression Results: Hypotheses Test Results

Variable	*Δln_Cost*		*Δln_COGS*		*Δln_SG&A*	
	Coeff.	t-stat	Coeff.	t-stat.	Coeff.	t-stat.
Intercept	0.420***	3.40	0.067	0.40	0.533***	2.92
Δln_Sales	0.514***	23.64	0.732***	24.74	0.399***	12.49
D×Δln_Sales	-0.171***	-3.14	-0.313***	-4.23	-0.160**	-2.02
Regulation×D×Δln_Sales	0.196***	3.78	0.042	0.60	0.374***	5.05
D	-0.075***	-5.96	0.005	0.27	-0.054***	-2.92
Regulation	-0.036**	-2.15	-0.035	-1.55	-0.059**	-2.37
BIG4	0.013	1.14	0.021	1.32	0.002	0.10
OPN	-0.053*	-1.96	0.187***	5.11	-0.175***	-4.38
SIZE	-0.010**	-2.05	-0.007	-1.1	-0.008	-1.10
LEV	-0.095***	-4.53	-0.059**	-2.07	-0.111***	-3.61
ROA	-0.125**	-2.40	-0.039	-0.55	-0.238***	-4.07
CFO	-0.105*	-1.83	-0.098	-1.25	-0.183**	-2.24
F-stat.	119.34***		168.78***		66.06***	
Adj. R^2	0.5951		0.6757		0.446	

Note 1) *, **, *** denote significance at 10%, 5%, 1% level based on two tailed test
Note 2) Variable definitions are as follows:

$\Delta ln\_Cost_{i,t}$ = *the change of the logarithm of costs of goods sold (COGS) and selling, general, and administrative costs (SG&A)*
$\Delta ln\_COGS_{i,t}$ = *the change of the logarithm of costs of goods sold (COGS)*
$\Delta ln\_SG\&A_{i,t}$ = *the change of the logarithm of selling, general, and administrative costs (SG&A)*
$\Delta ln\_Sales_{i,t}$ = *the change of the logarithm of sales (revenue)*
$D_{i,t}$ = *1 if sales of year t is smaller than that of year t-1, 0 otherwise*
$Regulation_{i,t}$ = *1 if year t is after adoption of pharmaceutical rebate regulation,0 otherwise*
$BIG4_{i,t}$ = *1 if external auditor is alliance with Big4, 0 otherwise*
$OPN_{i,t}$ = *1 if opinion of external auditor is "qualified", 0 otherwise*
$SIZE_{i,t}$ = *the logarithm of total assets*
$LEV_{i,t}$ = *leverage (=total liabilities/total assets)*
$ROA_{i,t}$ = *return on assets (=net income/total assets)*
$CFO_{i,t}$ = *cash flow from operating activities/total assets*
$\Sigma YD_{i,t}$ = *year dummy variables*

The analysis is as follows:First, an analysis of *Δln Cost* shows that the coefficient of *D*×*Δln Sales* is -0.171 (t-stat.=3.78), supporting hypothesis 1, which states that pharmaceutical firms will demonstrate cost stickiness. To analyze whether changes in cost behavior occurred since the adoption of the pharmaceutical rebate regulation, *Regulation*×*D*×*Δln_Sales* was reviewed. This recorded a statistically significant 0.196 (t-stat.=3.78), which supports hypothesis 2. This means that more cost-cutting efforts such as reducing marketing costs or laying off marketing personnel are employed by companies because of the government's rebate regulation. *Δln_COGS* and *Δln_SG&A* were analyzed to see if rebate costs were treated as manufacturing or SG&A costs.

Second, when *Δln COGS* is a dependent variable, *D*×*Δln Sales* was a statistically significant -0.313 (t-stat.=-4.23), whereas *Regulation*×*D*×*Δln Sales* was not statistically significant. This result shows that although no cost stickiness is present just as in general manufacturing businesses, no change is observed in cost behavior since adoption of the regulation. Therefore, hypothesis 1 is supported.

Third, an analysis of cost behavior changes in *Δln SG&A* shows that the coefficients of *D*×*Δln_Sales* and *Regulation*×*D*×*Δln_Sales* were -0.160 (t-stat.=-2.02) and 0.347 (t-stat.=5.05), respectively. Thus, unlike *Δln COGS, Δln SG&A* mitigated cost stickiness since the adoption of the pharmaceutical rebate regulation. This result can be interpreted as firms treating rebates as SG&A, and the regulation leading to a decrease in rebates. Therefore, hypotheses 1 and 2 are supported.

The BIG4 of the controlled variables were not statistically significant, however, OPN had a statistically significant negative sign in relation to *Δln_Cost* and *Δln_SG&A*, and a statistically significant positive sign in relation to *Δln_COGS*. This finding means that when a qualified opinion is received *Δln_Cost* and *Δln_SG&A* dropped whereas *Δln COGS* increased, and that the external auditor reduced pharmaceutical firm rebates. *SIZE, LEV, ROA,* and *CFO* mostly indicated statistically significant negative signs. Therefore, the larger the company, the higher the leverage ratio and the bigger the return on assets and cash flow resulting in more cost reduction.

V. Conclusion

Korea adopted the pharmaceutical rebate regulation in November 2010, by which the payment of rebates to medical institutions or doctors was banned. Recipients are punished under the new regulation as well. Pharmaceutical firms treat rebates as COGS or selling and administrative expenses. If the regulation leads to a drop in rebates, this can impact the cost of pharmaceutical firms as well. Thus, this study analyzed the effects of Korea's pharmaceutical rebate regulation on the cost behavior of pharmaceutical firms. The results are as follows:

First, similar to that in general manufacturing, cost stickiness was observed. The degree by which cost increases when sales increase and the degree by which cost drops when sales drop were asymmetrical. This result means that even when sales drop, minimal cost-cutting in the form of reduced marketing expenses or layoff of marketing personnel, in anticipation of sales increases down the road.

Second, an analysis of the effects of the pharmaceutical rebate regulation on pharmaceutical firms' cost behavior showed that it mitigated downward cost stickiness. Such a result can be seen as anecdotal evidence that dropped rebates and diminished sales, reduced marketing expenses or labor costs. Therefore, the pharmaceutical rebate regulation of Korea is regarded as effective in its purpose of regulating rebates.

This study is meaningful because it offers empirical results in contrast with the arguments of pharmaceutical firms and medical institutions that the pharmaceutical rebate regulation is ineffective. The study further offers policy implications for the government's pharmaceutical rebate regulation.

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