



## Effects of COVID-19 on the R&D Investment of Pharmaceutical Industry in South Korea

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### Dear Editor-in-Chief

The outbreak and spread of Covid19 crippled major economies both internationally and domestically due to supply and demand shocks. Most importantly, this period of Covid19 was an urgent time for the development of new vaccines, treatments, and medical equipment (1). In particular, corporate investment in R&D was negative overall during this period (2). Due to the lock-in between countries and the social distancing within countries, consumption has decreased and companies have reduced their production capacity due to the decrease in demand. As a result, the level of R&D investment by companies has decreased compared to the period before the Covid19 outbreak (3, 4). This paper examines the impact of Covid19 on the R&D investment of the pharmaceutical industry in South Korea. In particular, this paper analyzes the size of R&D investment, the type of investment, and the changes in the capitalization of R&D investment during the period of Covid19. This R&D investment behavior of the pharmaceutical industry indirectly shows how the pharmaceutical industry in South Korea responded to Covid19. In particular, capitalization of R&D investment means that R&D investment is successful and becomes assets such as intellectual property rights (patents).

In Table 1, the dependent variable is divided into three parts. ①Regarding the change in the size of R&D investment, the coefficients of Covid19 are statistically significant at 0.0161 (0.0061) and 0.1839 (0.0957), respectively. This means that R&D investment in the pharmaceutical industry increased during the COVID19 pandemic. ②In the analysis results of the change in R&D investment vehicle, the coefficient of Covid19 on outsourcing is statistically significant at 0.0290 (0.0175), which means that R&D investment through outsourcing to outside companies increased.

However, the coefficient of Covid19 on the dependent variable (internal HR) is statistically significant at -0.0419 (0.0244). This means that pharmaceutical companies have relatively reduced their R&D investment in internal research personnel in the COVID19 pandemic situation, which may have a negative impact on the competitiveness of Korean pharmaceutical companies in the end.

③And in the capitalization of R&D, the coefficient of Covid19 showed a statistically significant level of -0.0985 (0.0363). This result shows that although Korean pharmaceutical companies increased their R&D investment, the results of this investment were not positive.



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Meanwhile, among the control variables, Mid\_Firm had coefficients of  $-0.0105$  ( $0.0046$ ) and  $-0.1738$  ( $0.0718$ ) for R&D investment size at a statistically significant level, indicating that R&D investment actually decreased during the Covid19

period. However, the capitalization of R&D investment had a statistically significant coefficient of  $0.0872$  ( $0.0272$ ). This means that the performance of R&D investment, unlike that of large firms, is positive. The results of the remaining control variables are shown in Table 1.

**Table 1:** Results of ordinary linear regression

Variables	Dependent variables				
	(1) Change in R&D Investment Size		(2) Change in R&D Investment Vehicle		(3) Capitalization of R&D
	R&D per Asset	Ln(R&D)	Outsourcing	Internal HR	
<b>Intercept</b>	0.3822***( $0.0618$ )	2.7363***( $0.9626$ )	-0.6185***( $0.1779$ )	-0.0441( $0.2458$ )	-0.4570( $0.3649$ )
<b>Covid19</b>	0.0161***( $0.0061$ )	0.1839*( $0.0957$ )	0.0290*( $0.0175$ )	-0.0419*( $0.0244$ )	-0.0985***( $0.0363$ )
<b>Mid_Firm</b>	-0.0105**( $0.0046$ )	-0.1738**( $0.0718$ )	-0.0075( $0.0133$ )	-0.0365***( $0.0183$ )	0.0872***( $0.0272$ )
<b>Size</b>	-0.0129***( $0.0022$ )	0.7607***( $0.0344$ )	0.0260***( $0.0064$ )	0.0069( $0.0088$ )	0.0244*( $0.0130$ )
<b>Lev</b>	-0.0034***( $0.0008$ )	-0.0269**( $0.0124$ )	-0.0016( $0.0023$ )	0.0007( $0.0032$ )	0.0022( $0.0047$ )
<b>ROA</b>	-0.1472***( $0.0075$ )	-1.0686***( $0.1175$ )	-0.0391*( $0.0217$ )	0.1120***( $0.0300$ )	0.1150***( $0.0445$ )
<b>OPN</b>	-0.0023( $0.0230$ )	-0.0354( $0.3580$ )	0.0465( $0.0662$ )	0.2011**( $0.0914$ )	0.1596( $0.1357$ )
<b>BIG4</b>	0.0254***( $0.0038$ )	0.4448***( $0.0586$ )	0.0164( $0.0108$ )	-0.0214( $0.0150$ )	-0.0054( $0.0222$ )
<b><math>\Sigma YD</math></b>	Included	Included	Included	Included	Included
<b>F-stat.</b>	55.60***	107.97***	4.65***	4.45***	2.90***
<b>R<sup>2</sup></b>	0.3155	0.4725	0.0371	0.0356	0.0235
<b>Observations</b>	1,339				

Note: 1) ( ) is standard error and \*\*\*  $< 0.001$ , \*\*  $< 0.05$ , \*  $< 0.1$  (two-tailed)

2) The variables are defined as follows: Covid19: 1 if the period is 2020-2022, 0 otherwise; Mid\_Firm: 1 if a mid-sized firm, 0 otherwise; Size: log(assets); Lev: liabilities/assets; ROA: return on assets; OPN: unqualified opinion, 1 otherwise; BIG4: 1 if the external auditor is Big4, 0 otherwise;  $\Sigma YD$ : year dummy

The results of this study can be summarized as follows. First, Korean pharmaceutical companies quantitatively increased their R&D investment during the Covid19 period. In response to this pandemic, Korean pharmaceutical companies increased their investment in the development of new drugs and medical devices and made efforts to end this pandemic quickly. Second, because of the analysis of the method of increasing such R&D investment, R&D investment was made by outsourcing through overseas pharmaceutical companies or other domestic institutions rather than within the company. In addition, R&D investment in research personnel within the company actually decreased, which may have a negative impact on the ability to improve continuously new drug development or technology level in the future. Finally, although the amount of R&D investment has increased in the midst of the COVID-19 pandemic, the results of this investment leading to the company's intellectual property rights have relatively decreased. This

means that R&D investment has not led to an increase in corporate value or technological competitiveness. The results of this study suggest the need for prudent R&D investment decisions so that Korean pharmaceutical companies can increase their R&D investment and lead to the development of new drugs because of this investment.

## Conflict of interest

The author declares that there is no conflict of interest.

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