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The impact of R&D intensity, financial constraints, and dividend payout policy on firm value

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ABSTRACT

In this paper, we show that the effect of R&D on the value of financially constrained firms with dividend payout policy is much stronger than that on the value of firms without dividend payout policy. It is expected that financially constrained firms would tend to avoid paying out dividends. Nevertheless, recent studies on dividends show that the dividend policy of financially constrained firms could be utilized positively to provide a positive signal to the financial market. By extending those studies, our results show that the R&D of financially constrained firms with dividend payout policies have a significantly more positive impact on firm value than financially constrained non-dividend payers, and that the managers of financially constrained firms have incentives to use dividend payments to provide a positive impact of R&D performance on their firm value. We suggest that the dividend policy of R&D firms with financial constraints could be utilized to provide a positive signal to the financial market.

1. Introduction

Dividends can be used as rewards for investors or to maximize firm value. Dividend policy is one of the most important managerial decisions and has been examined extensively in the finance literature. According to the dividend signaling theory, a dividend payout could be considered by the market as a positive signal of a firm's future performance (Bhattacharya, 1979; Miller and Rock, 1985; Charitou et al., 2010; Skinner and Soltes, 2011). Nevertheless, dividend payouts generally worsen the liquidity and financial constraints of firms. The diminution in corporate liquidity may cause underinvestment, which leads to a loss of profitable investment opportunities, especially when a firm is financially constrained.

Financial constraints occur when there is substantial disparity between the cost of external financing and the opportunity cost of internal capital (Fazzari et al., 1988; Whited, 1992; Kaplan and Zingales, 1997). Consequently, constrained firms could be unable to finance projects with positive net present value. Previous studies have suggested that financial constraints have negative effects on the dividend payout policy of firms (DeAngelo and DeAngelo, 1990; Chen and Wang, 2012; Pathan et al., 2016). However, recent empirical studies have suggested that financially constrained firms pay dividends to shareholders and that the number of financially constrained firms that pay dividends increase over time (Skinner and Soltes, 2011; Jiang and Stark, 2013). Evidently, financially constrained firms have incentives to use dividends to establish good reputations to reduce future external financing costs (Howe and Lin, 1992; Gunasekarage and Power, 2002; Khang and King, 2006; Li and Zhao, 2008; Cheng et al., 2009).

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Generally, a firm's aggressive R&D activities have positive effects on its productivity and market valuation (Griliches, 1981; Hall, 1993; Gupta et al., 2017; Liao and Lin, 2017; Banker et al., 2019). Despite the role of R&D in the future growth of firms, it is generally considered to be subject to high levels of uncertainty. The establishment of an R&D program involves significant sunk costs, and it is costly to adjust the level of R&D spending (Czarnitzki and Hottenrott, 2011). The failed R&D projects of financially constrained firms could worsen investors' expectations of survival risks and competitive positions of such firms. Even so, recent studies have shown that for financially constrained firms, the effect of R&D on firm value is stronger than for unconstrained firms (Li. 2011; Gu, 2016). Consistent with the dividend signaling theory, we hypothesize that financially constrained firms with R&D could consider dividend payouts as an effective method for signaling their decent future prospects to the market.

Our study investigated whether the R&D of financially constrained firms with dividend payout policies is welcomed by market investors. To the best of our knowledge, this study is the first to investigate how the R&D investments of financially constrained firms with dividend payout policies affect the market value of these firms. The results of this study contribute to the understanding of the effects of the R&D activity of dividend-paying firms (payers) on firm value for financially constrained firms compared to that of non-dividend financially constrained firms (non-payers). Our finding states that the effect of R&D on firm value is positive and much stronger for payers than for non-payers. We show that managers of financially constrained firms could utilize dividends to provide positive signals of their future prospects.

2. Data and model

2.1. Data

We collected yearly accounting data from COMPUSTAT and stock return data from the Center for Research in Security Prices (CRSP). We included the data of all common shares listed on the NYSE, AMEX, and NASDAQ stock markets that had positive R&D expenses. Data from a given year with missing R&D expenditures were excluded. We only considered firms with positive R&D expenses in five consecutive years.

Among the firms with positive R&D expenses, we divided the firms into three groups based on the divisions of the ranked values of the Kaplan and Zingales (KZ) index, a widely used financial constraint proxy. Our test is only carried out on the top 30% group classified as *financially constrained firms*. The sample period covers 1980 to 2017 and includes 11,946 firm-years of *financially constrained firms*. Many studies typically define top 30% firms as constrained and bottom 30% firms as unconstrained firms instead of simply using the median. These financial portfolios were also kept over the entire year and rebalanced each year. For robustness of the analysis, additional tests were performed using the WW index, which shows a weak correlation with the KZ index, as an alternative financial constraint proxy (Kaplan and Zingales, 1997; Whited and Wu, 2006; Hadlock and Pierce, 2010). Refer to *Appendix A: KZ and WW index* for the description of how KZ and WW indexes were calculated.

2.2. Empirical model

We followed and modified the positive R&D-return relation from Chan et al. (2001) and Li (2011) by estimating the following equation:

$$\begin{aligned} FV_{i,\,t} = \beta + \theta_1 R\&D_{i,\,t-1} + \theta_2 DIVPOS_{i,\,t-1} + \ \theta_3 R\&D_{i,\,t-1} * DIVPOS_{i,\,t-1} + \theta_4 HHI_{i,\,t-1} + \ \theta_5 LogME_{i,\,t-1} + \theta_6 LogPB_{i,\,t-1} \\ + \theta_7 Momentum_{i,\,t} + \ \theta_8 ROA_{i,\,t-1} + \mu. \end{aligned} \tag{1}$$

where indexes *i* and *t* correspond to the firm and year, respectively. The dependent variable, firm value (FV) is the market value minus the book value of equity divided by the total assets of the firm (Pindado et al., 2010), which is the normalized value of the firm's excess market value. R&D intensity is calculated using R&D expenditure divided by total assets. Following the approach of Chan et al. (2001), we calculate R&D capital as the cumulative R&D intensities of five years depreciated by 20% annually. In particular, R&D capital for firm i in year t, $R\&D_{it}$, is a weighted average of the depreciated annual R&D intensities over the last five years, described as follows:

$$R\&D_{it} = RD_{it} + 0.8 * RD_{it-1} + 0.6 * RD_{it-2} + 0.4 * RD_{it-3} + 0.2 * RD_{it-4} \tag{2}$$

Table 1
Descriptive statistics of whole dataset.

Variable	Observation	Mean	Std. Dev.	Min	Max
Firm value	11946	1.082	2.867	-0.816	132.208
R&D	11946	3.532	56.756	0.000198	3720.9
DIVPOS	11285	0.252	0.434	0	1
HHI	11946	0.248	0.186	0.00731	1
ROA	11946	-0.0860	0.369	-10.331	0.850
logME	11946	5.465	2.572	-3.231	12.873
logPB	11946	-0.868	1.031	-8.783	2.879
Momentum	11946	-0.0424	2.448	-54.938	107.479
KZ index	11285	1.520	1.955	-0.523	64.889
WW index	11227	-0.256	0.398	-16.823	32.972

ROA is the income before extraordinary items for the fiscal year ending in year t−1 divided by total assets for the fiscal year ending in year t−2 (Li, 2011). DIVPOS is a dividend dummy if the firm pays cash dividends. LogME is the natural logarithm of market capitalization at the end of year t−1. LogPB is the natural logarithm of the ratio of the market value to the book value of equity for the fiscal year ending in year t−1. Momentum is the difference in firm value between year t and t−1. Product market concentration is measured using the Herfindahl–Hirschman Index (HHI), a measure commonly used by researchers in various areas of economics and finance. The descriptive statistics of the variables are presented in Table 1. Table 2 presents the correlation coefficients for the response and explanatory variables with Pearson correlation coefficients.

We expect the estimated R&D variable to have positive signs consistent with numerous other R&D-return literatures since R&D is perceived as a proxy of firm growth opportunities. We also expect that R&D investment of financially constrained firms with dividend payout policies will more positively impact firm value than non-dividend payers. The coefficient of HHI is expected to have negative signs since a higher HHI implies less competition. ROA is one of the indicators of how profitable a company is. Thus, a positive relationship between ROA and firm value is expected. The log of market equity is one of the widely accepted proxies of firm size. Since firm size and return relationship have mixed results from previous literature, the relationship between size and firm value could be either positive or negative. The relationship with the price-to-book ratio between the market value of a firm is expected to be negative. Momentum is an empirically observed tendency in the financial market where increases in the market value of a firm are persistent for a short period. Thus, a positive relationship between momentum and firm value is hypothesized.

To account for endogeneity, we tested our model with *industry R&D intensity* as an instrumental variable composed of industry R&D capital from the previous year, following Lev and Sougiannis (1996) and Aggarwal et al. (2010). We used the R&D capital variable both directly and as an interaction term with dividend dummy. Thus, we additionally adopted the interaction of the previous year's industry R&D capital with the dividend dummy as the second IV. With regard to the robustness of our results, we conducted an additional test with another widely accepted financial constraint measure, the WW index.

3. Empirical results

Table 3 illustrates the main estimates for the effects of R&D on firm value following Eq. (1). Columns 1 and 2 each depicts the regression estimates with financial constraint measure of KZ index or WW index, respectively. As expected, the estimation results confirm the positive effect of R&D intensity on firm value. The regression estimates for R&D intensity in both Columns 1 and 2 are significantly positive ($\widehat{\theta_1} = 0.00113$, $p< 0.01$; $\widehat{\theta_1} = 0.0087$, $p< 0.01$, respectively), which implies that, in general, financially constrained firms with higher R&D intensity hold higher firm value.

Our main finding is that the moderation effect of R&D intensity and dividend dummy is positive and statistically significant. The regression estimates for the interaction term of R&D intensity and dividend dummy in both Columns 1 and 2 are significantly positive ($\widehat{\theta_3} = 0.0609$, $p< 0.05$; $\widehat{\theta_3} = 0.0233$, $p< 0.05$, respectively). This result implies that the effect of R&D on the value of financially constrained firms with dividend payout policy is much stronger than on the value of firms without dividend payout policy. Not only exists the R&D effect for financially constrained firms, but the interaction effect of R&D intensity and dividend policy is also relatively effective for financially constrained firms.

Likewise, the Log of market equity and Momentum has a positive relationship with firm value as anticipated. As expected, the Log of the Price-to-Book ratio also shows a negative relationship with firm value. Contrary to our prediction, in the case of the ROA, the signs of the ROA variables are negative. The test statistics to confirm the validity of instruments are also stated in Table 3. The result of the Wu-Hausman test supports our methodology to treating variables as endogeneous.

Our empirical results suggest a significant difference between financially constrained dividend paying firms and nonpaying firms in terms of the impact of R&D intensity. Consistent with previous literature on the effect of R&D, we confirm the significant and positive R&D-firm value relation despite dividend payout policy. Our main finding is that the impact of R&D on firm value of financially constrained dividend paying firms is significantly greater than that of financially constrained firms without dividend payout policy. Thus, we contribute to the existing literature on the dividend puzzle by providing empirical results on the effect of R&D on firm value.

Table 2
Pearson correlation table.

	Firm value	R&D	DIVPOS	HHI	ROA	logME	logPB	Momentum	KZ index
Firm value	1								
R&D	0.0968*	1							
DIVPOS	-0.0879*	-0.0285*	1						
HHI	-0.0601*	-0.0165	0.0413*	1					
ROA	-0.3296*	-0.1149*	0.1270*	0.0521*	1				
logME	0.0067	-0.0171	0.3960*	-0.0347*	0.2188*	1			
logPB	-0.4595*	-0.0851*	0.0448*	0.0804*	0.2462*	-0.0946*	1		
Momentum	0.4245*	0.0093	0.0139	0.004	-0.0107	0.0244*	0.1616*	1	
KZ index	0.2595*	0.0678*	-0.0994*	0.0094	-0.4627*	-0.1373*	-0.2591*	-0.1094*	1
WW index	0.0436*	-0.0784*	-0.1915*	0.0298*	-0.1300*	-0.2941*	-0.0345*	-0.0241*	0.1444*

Table 3
2SLS test of a full sample of financially constrained firms with the dividend dummy and the interaction variable (R&D and dividend).

	(1) KZ index	(2) WW index
R&D	0.00113***	0.00870***
	(0.00347)	(0.00191)
R&D * Dividend Dummy	0.0609**	0.0233**
	(0.0304)	(0.00958)
Dividend Dummy	-0.447***	-0.418***
	(0.0683)	(0.0749)
HHI	-0.0991	0.0463
	(0.117)	(0.112)
ROA	-1.224***	-0.294***
	(0.0898)	(0.0394)
Log of Market Equity	0.0295***	0.119***
	(0.0102)	(0.0136)
Log of Price-to-Book Ratio	-1.330***	-1.633***
	(0.0286)	(0.0241)
Momentum	0.578***	0.674***
	(0.00895)	(0.00829)
Observations	11285	11227
Wu-Hausman F	5.785	13.508
p-value	0.0031	0

This table displays the estimates of the impact of R&D investment on the market value of firms. We classified firms into financially constrained and unconstrained firms according to the KZ index or WW index. The regression model has the following form: $FV_{i,t} = \beta + \theta_1 R\&D_{i,t-1} + \theta_2 DIVPOS_{i,t-1} + \theta_3 R\&D_{i,t-1} * DIVPOS_{i,t-1} + \theta_4 HHI_{i,t-1} + \theta_5 LogME_{i,t-1} + \theta_6 LogPB_{i,t-1} + \theta_7 Momentum_{i,t} + \theta_8 ROA_{i,t-1} + \mu$. The dependent variable, firm value (FV), is market value minus the book value of equity and divided by the total assets of the firm. R&D intensity is calculated by R&D expenditure divided by total assets. DIVPOS is a dividend dummy if the firm pays cash dividends. HHI is product market concentration for the fiscal year ending in year t−1. ROA is income before extraordinary items for the fiscal year ending in year t−1, divided by total assets for the fiscal year ending in year t−2. logME is the natural logarithm of market capitalization at the end of year t−1. logPB is the natural logarithm of the ratio of market value to book value of equity for the fiscal year ending in year t−1. Momentum is the difference in firm value in year t to t−1. The table exhibits the coefficients of 2SLS regressions with industry R&D intensity for the fiscal year ending in year t−2 as an instrumental variable. The Wu–Hausman endogeneity test is provided for judging the validity of the instruments at the bottom part of Table. Robust standard errors are in parentheses. The significance levels of 1%, 5%, and 10% are denoted by ***, **, and *, respectively.

4. Conclusions

We thoroughly examined how the R&D investments of financially constrained firms with and without dividend payout policy influence firm value. In this study, we assessed the puzzling phenomenon of dividend payouts of financially constrained firms. We empirically show that financially constrained firms with dividend payout policy experience a more positive R&D impact on firm value than firms without dividend payout policy. We suggest that dividend payout policy of financially constrained R&D firms is effective at enhancing firm value through future opportunities to acquire external financing in stock markets. Financially constrained firms with dividend payout policies receive more confidence from market investors than firms without dividend policy when conducting R&D.

We believe that our findings contribute to the existing literature on the relationships among R&D, dividend policy, and financial constraints. We contribute to the puzzling phenomenon of dividends from financially constrained firms with R&D. We explain this decision by utilizing the signaling theory. Financially constrained firm managers can draw upon our results in their decision-making process as they consider financial policy concerning R&D.

CRediT authorship contribution statement

JooMan Kim: Software, Data curation, Writing - original draft. **Insun Yang:** Conceptualization, Methodology, Writing - review & editing, Supervision. **Taeyong Yang:** Supervision. **Peter Koveos:** Supervision.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.frl.2020.101802.

Appendix A. KZ and WW indices

This appendix is rewritten here with reference to Li (2011). Refer to the Appendix of Li (2011) for a more detailed explanation of

the computation of financial constraint indices.

The KZ index is computed as follows:

$$KZ = -1.001909 * CashFlow/K + 0.2826389 * Tobin'sQ + 3.139193 * Debt/TotalCapital - 39.3678 * Dividends/K - 1.314759 * Cash/K$$

where K refers to property, plant, and equipment.

The WW index is computed as follows:

$$WW = -0.091 * CF - 0.062 * DIVPOS + 0.021 * TLTD - 0.044 * LNTA + 0.102 * ISG - 0.035 * SG$$

where CF is the ratio of cash flow to total assets; DIVPOS is a dividend dummy if the firm pays cash dividends; TLTD is the ratio of long-term debt to total assets; LNTA is the natural log of total assets; ISG is the firm's three-digit industry sales growth; and SG is the firm sales growth.

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