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Does sentiment influence corporate innovation investment?

Karam Kim [a], Jonathan A. Batten [b,c,*], Doojin Ryu [a,*]

[a] Department of Economics, Sungkyunkwan University, Seoul, Republic of Korea
[b] College of Business and Law, Royal Melbourne Institute of Technology, Victoria, Australia
[c] Corvinus Institute of Advanced Studies, Corvinus University, Budapest, Hungary

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ABSTRACT

This study examines whether market sentiment affects innovation investment by firms in an emerging market, focusing on Korean firms. We find a significantly positive relationship between market sentiment and innovation investment. For financially constrained firms, sentiment increases both innovation and physical investment, which indicates reliance on sentiment driven equity financing. Firms that are affiliated with chaebols are more likely to adjust research and development investment in response to market sentiment. During periods of high market uncertainty such as the COVID 19 period, the effect of market sentiment on research and development decisions is stronger for financially unconstrained firms. Managerial sentiment amplifies the effect of market sentiment on innovation but does not influence physical investment. Our results show that sentiment acts as an alternative financing mechanism that supports innovation in financially constrained firms.

1. Introduction

Existing studies show that innovation investment is essential for a firm's long-term survival. However, firms may hesitate to invest because of uncertain outcomes and high upfront costs (Coiculescu et al., 2024). External factors, such as policy uncertainty, corruption, and government subsidies, also affect innovation (Bhattacharya et al., 2017; Ellis et al., 2020; Howell, 2017). Recent research highlights the effect of behavioral forces, such as market sentiment, on firms' strategic investment decisions. For example, Dang and Xu (2018) find that sentiment significantly affects innovation in developed markets. However, its role in emerging markets, where financial systems are often underdeveloped, governments prioritize economic growth and industrial advancement, and firms face more severe financing constraints, remains unclear.

This study addresses this gap by examining how market and managerial sentiment affect innovation investment in Korea, a country that has historically relied on bank-based financing and has more recently adopted market-based alternatives through the development of corporate bond markets (Batten and Szilagyi, 2007). We find that market sentiment significantly increases innovation investment, particularly during periods of heightened uncertainty and among financially constrained firms. Among these firms, chaebol affiliates, which generally invest more in R&D than non-chaebol firms, are more responsive to market sentiment in their R&D decisions. Managerial sentiment further strengthens this effect, but only for innovation investment, not for physical investment. These results contribute to the literature by identifying sentiment-driven equity issuance as an important financing mechanism in emerging markets and by highlighting the behavioral aspects of corporate investment decisions. Our findings show that in capital-scarce environments,

* Corresponding authors at: Global Finance Research Center, Sungkyunkwan University, Seoul, Republic of Korea.
E-mail addresses: jonathan.batten@rmit.edu.au (J.A. Batten), sharpjin@skku.edu (D. Ryu).

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sentiment can effectively substitute for traditional financial intermediation.

Emerging countries increasingly need to invest in innovation to support industrial transformation and ensure long-term economic growth. Although economies such as Vietnam, China, and the Republic of Korea have historically achieved rapid development through the expansion of traditional manufacturing-based industries, they are now expected to promote the growth of research and development (R&D)-intensive sectors to sustain future progress (Tsai et al., 2009). However, innovation investment requires substantial financing, which firms in these markets often struggle to secure because of underdeveloped financial systems (Ayyagari et al., 2011; Hsu et al., 2014). O'Toole and Newman (2017) show that financially less-developed countries face higher external financing costs due to high interest rates, limited liquidity, and increased term risk.

These structural barriers significantly hinder firms' ability to invest in innovation. Since industrial transformation in emerging markets progresses more slowly than in developed economies, globalization creates stronger incentives for these firms to innovate (Gorodnichenko et al., 2010). However, financially constrained firms still face substantial barriers to funding innovation. Our study provides novel evidence on how such firms secure capital under financing frictions to sustain innovation and then highlights the importance of alternative financing mechanisms in emerging market contexts by extending prior research.

Investor sentiment is a critical financing channel for firms, particularly in emerging markets where access to traditional capital sources is limited. It reflects investors' expectations about future market conditions and often diverges from firm fundamentals (Baker and Wurgler, 2006). In optimistic or pessimistic sentiment environments, investors expect prices to rise or fall, resulting in firm overvaluation or undervaluation even when fundamentals remain unchanged (Lee and Ryu, 2024). Lamont and Stein (2006) show that rational managers respond strategically by issuing equity when their firms appear overvalued.

This is particularly relevant in emerging markets like Korea, where sentiment more strongly drives asset prices (Kim, Ryu, and Yang, 2021; Wang, 2024). Financially constrained Korean firms often raise equity capital during periods of high market sentiment, using inflated valuations as a substitute for limited access to traditional financial intermediation. As uninformed investors actively trade in the market (Hu et al., 2024), stock prices become increasingly sensitive to sentiment shifts (Ryu et al., 2023). Because innovation investment often depends on external equity financing, this sentiment-driven financing channel is especially important in Korea. These factors make Korea an ideal setting for empirically examining how market sentiment affects innovation investment.

Using firm-level data from the Korean stock market from 2010 to 2023, we examine whether market sentiment affects corporate innovation investment in an emerging market. Our findings are as follows. First, the effect of market sentiment on innovation investment is significantly positive and particularly stronger for financially unconstrained firms during the COVID-19 period. These results suggest the importance of market sentiment in supporting traditional financing under increased uncertainty. Second, this effect is more pronounced for financially constrained firms that inevitably rely on external market conditions to raise capital through equity financing when internal funds are limited. Third, market sentiment has a greater effect on innovation decisions for financially constrained and chaebol-affiliated firms, indicating that chaebols are more willing to maintain R&D investment despite financing friction. Fourth, market sentiment positively affects physical investment only for financially constrained firms, suggesting these firms face financing needs for both innovation and capital expenditure. Fifth, while managerial sentiment reinforces the effect of market sentiment on innovation investment, it does not significantly affect physical investment. This finding is consistent with managerial confidence being more important for high-risk, long-term innovation decisions than for tangible asset allocation.

We highlight three key contributions to the literature on corporate investment and financial constraints in emerging markets. First, we present new evidence that firms engaging in R&D activities require more financing than those without such investments. While firms in developed economies have already shifted toward R&D-intensive sectors following the R&D boom (Brown et al., 2009), firms in emerging markets have advanced more slowly because of their reliance on traditional manufacturing industries. However, increasing globalization now provides stronger incentives for these firms to invest in innovation (Narula and Santangelo, 2009). Our findings show that market sentiment positively influences both R&D and physical investments for financially constrained firms investing in R&D, indicating that these firms experience financing pressures until they achieve a sustainable level of R&D intensity. Given Korea's position as a representative case of an emerging economy undergoing industrial transition, our results offer important policy implications for reducing financial barriers that hinder innovation-led growth in similar contexts.

Second, we document distinct heterogeneities in firms' responses to market sentiment. With respect to ownership structure, chaebol affiliation significantly moderates the effect of market sentiment on innovation investment, especially under financial constraints. Previous studies show that chaebol-affiliated firms are more innovative (Choi et al., 2020; Joe and Oh, 2018), and we consistently suggest that chaebol-affiliated and financially constrained firms have an incentive to use sentiment-driven financing. Regarding the exogenous shock, the COVID-19 pandemic increases capital market uncertainty and raises the cost of external finance even for financially unconstrained firms. During this period, the effect of market sentiment on their innovation investment is significantly stronger, indicating that market sentiment can serve as an alternative financing channel when traditional financing sources are disrupted. By jointly considering chaebol affiliation and the pandemic shock, our study provides novel evidence on how institutional structures and macroeconomic crises interact to shape firms' innovation investment decisions using market sentiment.

We emphasize the role of managerial sentiment in shaping innovation investment decisions. Our findings show that managerial sentiment amplifies the effect of market sentiment on innovation investment but does not significantly affect physical investment. This asymmetry reflects the unique characteristics of innovation investment, which involves intangible assets with low collateral value and high uncertainty, requiring managers to maintain strong confidence in their firm's long-term prospects. In contrast, physical investments involve tangible assets with higher collateral value and more predictable returns, so managers respond more to traditional cost-of-capital considerations. These results indicate that managerial overconfidence affects investment decisions unevenly, playing a greater role in high-risk, forward-looking innovation projects than in conventional capital expenditures.

The remainder of this paper is organized as follows. Section 2 describes the sample data and measures. Section 3 presents baseline

Table 1
Descriptive statistics.

	N	Mean	Std	Min	P25	Median	P75	Max
Innov	7494	0.874	1.458	0.000	0.012	0.250	1.070	8.981
Sales	7000	20.008	1.712	11.366	18.892	19.848	20.957	26.434
PPE	6492	12.911	1.672	5.342	12.017	12.744	13.515	20.075
TobinQ	6429	1.106	0.591	0.254	0.770	0.934	1.223	4.628
ROA	6881	0.023	0.065	−0.315	0.003	0.027	0.057	0.201
Lev	7021	0.468	0.198	0.000	0.313	0.481	0.616	0.999
Cash	6951	0.075	0.062	0.000	0.029	0.061	0.104	0.343
ΔMktSent	14	0.014	0.306	−0.560	−0.183	0.004	0.184	0.641
GDPVolat	14	0.009	0.005	0.001	0.006	0.008	0.010	0.020
EPU	14	1.059	0.193	0.792	0.920	1.038	1.159	1.502

Notes. This table reports the summary statistics. *N*, *Mean*, *Std*, *Min*, *P25*, *Median*, *P75*, and *Max* indicate the number of observations, mean, standard deviation, minimum, 25th percentile, median, 75th percentile, and maximum, respectively. *Innov* denotes the ratio of R&D expenditure to total assets. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets, scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *ΔMktSent*, *GDPVolat*, and *EPU* indicate the change in market sentiment, volatility of GDP growth, and economic policy uncertainty, respectively.

results for the relationship between market sentiment and innovation investment. Section 4 provides the mechanisms underlying this relationship. Section 5 checks robustness, and Section 6 concludes the paper.

2. Data and measures

Korea holds a distinctive position at the intersection of developed and emerging economies in terms of economic scale and institutional development. According to the World Economic Outlook Database of the International Monetary Fund, in 2023, Korea's per capita GDP was approximately USD 35,000, similar to that of G7 members Japan (USD 34,000) and Italy (USD 39,000). Although Korea's economic growth has historically depended on traditional manufacturing industries, the country now faces increasing pressure to shift toward innovation-driven growth (Aghion et al., 2021). This shift is urgent because large business groups (chaebols) compete globally, making sustained innovation investment essential for long-term competitiveness. The transformation is especially relevant in the current policy environment, which prioritizes digitalization, green innovation, and global value chain resilience. Despite its sizable economy, Korea's financial market remains relatively underdeveloped and shows considerable information asymmetry among investors (Kim et al., 2024; Ryu et al., 2022).

Because firms voluntarily announce R&D expenditure, we examine firms listed on the Korea Composite Stock Price Index (KOSPI) market, which comprises larger and more liquid firms in Korea, to ensure reliable R&D expenditure data. We obtain firm-level financial data from DataGuide. Macroeconomic data are sourced from the Economic Statistics System of the Bank of Korea and the Economic Policy Uncertainty website (www.policyuncertainty.com). The sample period covers January 2010–December 2023. We exclude firms in the financial industry, those with capital impairment, and firms with missing total assets. We also include only firms with five consecutive years of financial statements. The final sample consists of 572 firms.

The market sentiment index is constructed using the methodology of previous studies (Seok et al., 2024a). We use the KOSPI 200 index data to create five sentiment proxies: the relative strength index, psychological line index, adjusted turnover ratio, logarithm of trading volume, and individual investors' buy–sell imbalances. These variables are orthogonalized by controlling for macroeconomic conditions and then standardized. The four macroeconomic variables are the risk-free rate, the credit spread between 3-year government and corporate bond yields, the term spread between 3-year and 10-year government bond yields, and the change in implied volatility. We apply principal component analysis and construct the sentiment index by linearly combining each eigenvector with its corresponding orthogonalized sentiment proxy. The resulting market-level sentiment index (*MktSent*) is standardized.

To examine whether market sentiment influences firms' innovation investment decisions, we use the ratio of R&D expenditure to total assets (*Innov*), measured at the beginning of the fiscal year, as a proxy for corporate innovation activity. Common proxies for firm R&D activity include the R&D investment ratio, the number of patents, and the number of citations (Luong et al., 2017; Singh, 2008). Jiang et al. (2026) argue that the number of patents or citations reflects the outcome of R&D activities, while the R&D investment ratio captures the firm's input into R&D. Because we focus on how market sentiment influences firms' R&D investment decisions, we use the R&D investment ratio, an input-based measure of R&D activity, as our primary variable.

We also include a set of firm-specific control variables. *Sales* is defined as the natural logarithm of total sales, and *PPE* is measured as the logarithm of tangible assets per employee. *TobinQ* represents the ratio of a firm's market value to the book value of its total assets. *Lev* and *Cash* are calculated as the ratio of total debt and cash to total assets, respectively. Because *Innov*, *TobinQ*, and *Cash* are positively skewed and non-negative variables, each variable is winsorized at the top 1%. *ROA* is winsorized at both the top and bottom 1% to mitigate the influence of extreme values.

Table 1 shows the summary statistics of all variables. *Innov* has a value of zero up to the 25th percentile, indicating that it should be winsorized because of highly positive skewness. The average of *Innov* is 0.874%. Compared to the average R&D spending ratio of approximately 6% in developed markets (He and Wintoki, 2016), firms in emerging markets exhibit considerably lower R&D investment levels. The average of *ΔMktSent* is 0.014, which is greater than the median value (i.e., 0.004), indicating that investor sentiment in the KOSPI market has generally shown a positive trend over the sample period.

Table 2
Baseline results.

	Panel		PPML	
	M1	M2	M3	M4
ΔMktSent	0.038**	0.038**	0.048**	0.050*
	(2.27)	(2.26)	(2.02)	(1.72)
Sales	0.172***	0.163***	0.214***	0.203***
	(3.97)	(3.87)	(3.91)	(3.74)
PPE	−0.044	−0.048*	−0.069	−0.075*
	(−1.62)	(−1.79)	(−1.55)	(−1.67)
TobinQ	0.103**	0.103**	0.079**	0.078**
	(2.08)	(2.09)	(1.97)	(2.00)
ROA	−0.643**	−0.603**	−0.761**	−0.711**
	(−2.35)	(−2.26)	(−2.30)	(−2.28)
Lev	−0.018	0.007	0.053	0.069
	(−0.09)	(0.03)	(0.26)	(0.33)
Cash	0.278	0.238	0.234	0.195
	(0.95)	(0.82)	(0.79)	(0.67)
GDPVolat		2.278		3.113**
		(1.33)		(2.02)
EPU		0.078		0.062
		(1.29)		(0.94)
Intercept	−2.156**	−2.029**	−2.892***	−2.707***
	(−2.43)	(−2.36)	(−2.80)	(−2.64)
N	6192	6192	6117	6117
Firm	Yes	Yes	Yes	Yes
R^2	0.0189	0.0199	0.4933	0.4934

Notes. This table indicates that market sentiment influences innovation investment. The columns labeled *Panel* (*PPML*) present the results using panel (PPML) regression. *ΔMktSent* denotes the change in market sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Standard errors are clustered at the firm level. Figures in parentheses are *t*-statistics. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

3. Empirical findings

We examine whether market sentiment influences innovation investment by conducting a panel data regression, as shown in Eq. (1). For firm *i* in year *y*, *Innov* denotes the ratio of R&D expenditure, and *ΔMktSent* represents the change in the market sentiment index. In emerging markets, investor sentiment often fluctuates (Kim, Ryu, and Yu, 2021). If managers adjust innovation investment in response to market sentiment, the relative change in sentiment is more important than the annual average. Therefore, we use the change in market sentiment rather than its level. If market sentiment affects corporate innovation investment, the coefficient of *ΔMktSent* (β_1) is significant:

$$Innov_{i,y} = \beta_0 + \beta_1 \Delta MktSent_y + \gamma' X_{i,y-1} + \rho' \tau_y + \delta_i + \varepsilon_{i,y}, \quad (1)$$

where *X* denotes the set of firm characteristics, including *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash*. Firm-level control variables are related to firm size, tangibility, profitability, growth, and liquidity, according to Dang and Xu (2018). We use the lagged terms of the firm-level control variables to mitigate endogeneity. τ denotes the set of macroeconomic variables, including the volatility of GDP growth (*GDPVolat*) and economic policy uncertainty (*EPU*). These macroeconomic variables are used contemporaneously to control for the macroeconomic conditions in year *y*. We additionally control unobservable firm effects using δ_i.

Because *Innov* is non-negative and highly skewed, the estimated effect of market sentiment on R&D expenditure is likely to be biased. To correct this bias, we use a Poisson pseudo maximum likelihood (PPML) regression, following previous studies (Cincera, 1997; Koh and Reeb, 2015), as shown in Eq. (2):

$$Innov_{i,y} = exp\left(\beta_0 + \beta_1 \Delta MktSent_y + \gamma' X_{i,y-1} + \rho' \tau_y + \delta_i + \varepsilon_{i,y}\right). \quad (2)$$

Whereas PPML regression obtains converged estimates through iterations and excludes observations with missing values, panel data regression retains observations with missing values in the dependent variable. This results in a difference in the number of dropped observations between the two methods. We use both panel data and PPML regressions to check robustness by addressing estimation errors.

Table 2 presents the results for the sample excluding firms without R&D investment.[1] The columns labeled *Panel* show the panel

[1] Our findings remain consistent, even when firms without R&D investment are included.

data regression results, while the columns labeled *PPML* report the PPML regression results. The coefficient of *ΔMktSent* is significantly positive, indicating that corporate innovation investment increases when market sentiment is optimistic. This relationship remains significant after controlling for macroeconomic conditions, as shown in Models *M2* and *M4*. In Model M2, the estimated coefficient of *ΔMktSent* (i.e., 0.038) suggests that the increase in innovation is approximately 0.012 percentage points, which corresponds to roughly 1.37% of the average Innov (i.e., 0.874%), when *ΔMktSent* increases by one standard deviation. Given that the average value of total assets is approximately $3.2 billion based on the 2023 USD-KRW exchange rate, a one standard deviation increase in market sentiment is associated with an increase of about $0.65 million in R&D spending, which corresponds to roughly a 2.32% increase in R&D investment. Therefore, this effect is economically meaningful.

We also interpret the estimated coefficients of the firm-level control variables to provide further insights into their effects on innovation investment. The coefficient for *Sales* is significantly positive, aligning with Knott and Vieregger's (2020) finding that firm size is positively associated with innovation investment. Gorodnichenko et al. (2010) indicate that firms in emerging markets often increase innovation to strengthen their international competitiveness in the context of globalization. The coefficient for *TobinQ* is significantly positive, whereas those for *PPE* and *ROA* are generally significant and negative. These results indicate that firms with higher growth opportunities, lower asset tangibility, and lower profitability tend to invest more in innovation, consistent with previous findings (Chi et al., 2020; Peters and Taylor, 2017).

4. Mechanism test

4.1. Financing channel

Because innovation projects require substantial upfront investment, firm managers must secure adequate funding. Firms with ample internal financing may not need to consider external conditions; however, those with limited internal funds and external financing constraints must prioritize obtaining capital for innovation projects (Ding et al., 2022; Li, 2011). Market sentiment can be an effective financing strategy for these firms, as it allows them to raise funds or lower capital costs without changes in fundamental value. When investor sentiment is optimistic, managers may use temporarily overvalued equity to raise capital and increase innovation investment. Therefore, we expect the effect of market sentiment on innovation investment to be more pronounced for financially constrained firms.

Dang and Xu (2018) use firm size, the Size-Age (SA) index, the dividend payout ratio, predicted free cash flow, and investment sensitivity to cash flow as proxies for financial constraints. However, except for the SA index, these proxies do not accurately indicate financial constraints in our sample. First, firm size is an unsuitable proxy for financial constraints in emerging markets. In developed markets, smaller firms often have a greater incentive to invest in innovation to survive, even when financially constrained. In contrast, in emerging markets, where financial development is less advanced than in developed markets (Wang et al., 2021), small firms often lack the capacity to invest in innovation. Firms of sufficient size not only have the resources to conduct R&D projects but also a strong incentive to invest in innovation to stay competitive in international markets (Bilir and Morales, 2020). Prior studies support this distinction, showing that firm size is negatively related to innovation investment in developed markets and positively related in emerging markets (Liu et al., 2020; Zhang, 2015).

Second, the dividend payout ratio is an unsuitable proxy for distinguishing the financing channel because dividend payments are extremely low. The average payout ratio in the low-payout group (bottom tertile) is 0.02%, while in the high-payout group (top tertile) it is 2.46%. Given the standard deviation within the high-payout group, the difference between these groups is practically negligible. Therefore, categorizing firms by payout ratios may not adequately capture differences in the financing channel in emerging markets.

Third, predicted free cash flow and investment cash flow sensitivity are subject to measurement errors. We calculate these variables using firm-level regressions; however, our sample includes a maximum of 14 observations per firm, resulting in statistically unreliable estimates. Therefore, these proxies cannot capture differences in the financing channel. For these reasons, we use only the SA index as the proxy for financial constraints in our analysis. Following Hadlock and Pierce (2010), who indicate that the relationship between firm size and financial constraints is non-linear, while the relationship between firm age and financial constraints is linear, we calculate the SA index as shown in Eq. (3):

$$SA\ index_{i,y} = -0.737 \times Size_{i,y} + 0.043 \times Size_{i,y}^{2} - 0.040 \times Age_{i,y}, \tag{3}$$

where the *SA index* is a combination of firm size and age. *Size* and *Age* denote the logarithm of total assets and the duration since the firm's initial public offering for firm *i* in year *y*, respectively. Total assets are adjusted for inflation based on the 2020 Korean won. If the actual values of inflation-adjusted total assets and *Age* exceed KRW 5.31 trillion and 37 years, respectively, we replace them with these thresholds.[2]

Table 3 presents the results, showing that the effect of market sentiment on innovation investment varies by the degree of financial constraint. The columns labeled *Constrained* (*Unconstrained*) report the results for the subsample of financially constrained (unconstrained) firms in the high (low) SA index group. The coefficient of *ΔMktSent* is significantly positive in the *Constrained* columns, and

[2] Hadlock and Pierce (2010) demonstrate that the relationship between financial constraints and firm characteristics levels off when inflation-adjusted total assets exceed USD 4.5 billion and firm age exceeds 37 years. Using the 2020 won–dollar exchange rate, we set the thresholds for firm size and age at KRW 5.31 trillion and 37 years, respectively.

Table 3
Financing channel in the impact of market sentiment.

	Constrained		Unconstrained	
	Panel	PPML	Panel	PPML
ΔMktSent	0.040**	0.040*	0.063	0.077
	(2.28)	(1.77)	(1.62)	(1.64)
Sales	0.066	0.129	0.255***	0.293***
	(1.50)	(1.57)	(2.97)	(2.76)
PPE	−0.042	−0.127*	0.005	−0.002
	(−1.46)	(−1.81)	(0.10)	(−0.04)
TobinQ	0.045	0.039	0.128	0.100*
	(0.94)	(0.87)	(1.59)	(1.83)
ROA	−0.600*	−0.815**	−0.671*	−0.769*
	(−1.84)	(−2.10)	(−1.94)	(−1.80)
Lev	−0.400	−0.308	0.417	0.421
	(−1.37)	(−1.17)	(1.31)	(1.23)
Cash	−0.539	−0.593	0.552	0.381
	(−0.94)	(−1.07)	(1.20)	(0.88)
GDPVolat	−0.605	−0.352	7.610**	9.291**
	(−0.30)	(−0.16)	(2.32)	(2.51)
EPU	−0.052	−0.055	0.237**	0.242*
	(−0.58)	(−0.57)	(2.14)	(1.94)
Intercept	0.271	−0.161	−4.640***	−5.510***
	(0.29)	(−0.10)	(−3.13)	(−3.14)
N	2111	2079	1992	1940
Firm	Yes	Yes	Yes	Yes
R^2	0.0123	0.5398	0.0519	0.4455

Notes. This table shows that the effect of market sentiment on innovation investment varies across financial constraints. The columns labeled *Constrained* (*Unconstrained*) indicate the results using the sample, including firms in the top (bottom) tertile of the SA index. The columns labeled *Panel* (*PPML*) present the results using panel (PPML) regression. *ΔMktSent* denotes the change in market sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

not significant in the *Unconstrained* columns. These findings suggest that the effect of market sentiment is stronger for financially constrained firms. Financially unconstrained firms are less concerned about stock overvaluation when making innovation investment decisions, whereas financially constrained firms are more likely to use overvaluation to reduce their cost of capital.

We empirically examine whether financially constrained firms raise capital through seasoned equity offerings (SEOs) when market sentiment is optimistic. Financially constrained firms are more likely to use equity financing than debt financing because they have limited access to credit markets. If firms increase innovation investment by taking advantage of sentiment-driven financing opportunities, they are more likely to issue equity during periods of high market sentiment. To test this mechanism, we analyze the effect of market sentiment on stock issuance using monthly data rather than annual data. Because emerging markets show greater variation in investor sentiment than developed markets (Chen et al., 2021; Kim et al., 2025), measuring sentiment around the time of the SEO decision provides a more accurate estimate of its effect on stock issuance.

To measure stock issuance, we use two dependent variables: the likelihood of equity issuance and the incremental market value following the SEO. The likelihood of equity issuance is defined as a binary variable equal to one when a firm increases its total number of outstanding shares compared to the previous month, and zero otherwise. Because this variable is binary, we estimate a probit regression to examine how changes in market sentiment affect the likelihood of equity issuance.

Next, we use the incremental market value following SEOs as an alternative dependent variable. The likelihood of equity issuance may not accurately represent equity financing because it can be affected by non-cash events, such as stock dividends or convertible bond conversions. To address this measurement error, we construct a variable that captures the actual market value raised through SEOs. Specifically, we calculate the difference between market capitalization at the opening price on the issuance date and the previous day's market capitalization. We aggregate this value monthly and scale it by total assets at the beginning of the fiscal year. Because this variable is a non-negative continuous variable and highly positively skewed, we use a PPML regression rather than a probit model.

Table 4 presents the impact of market sentiment on stock issuance. The columns labeled *Probit* report the results from probit regressions, with the likelihood of equity issuance as the dependent variable. The columns labeled *PPML* report the results from PPML regressions, using the incremental market value following the SEOs as the dependent variable. *DConstrained* is a dummy variable equal to one if a firm belongs to the top tertile of the SA index, and zero otherwise. *ΔMktSent*×*DConstrained* denotes the interaction term between *ΔMktSent* and *DConstrained*. To control for macro-level and time-varying effects, we include the risk-free rate (*Rf*), the change in implied volatility (*ΔVkospi*), and economic policy uncertainty (*EPU*) as control variables. If the coefficient of the interaction term between *ΔMktSent* and *DConstrained* is significantly positive, it suggests that financially constrained firms rely more on investor sentiment when making equity issuance decisions.

Table 4
Impact of market sentiment on stock issuance.

	Probit		PPML	
	DIssuance	DIssuance	RIssuance	RIssuance
ΔMktSent	0.026	0.030	−0.105	−0.108
	(1.40)	(1.61)	(−1.24)	(−1.29)
DConstrained	0.167***	0.154***	0.758***	0.756***
	(3.60)	(3.31)	(2.89)	(2.93)
ΔMktSent × DConstrained	0.062**	0.063**	0.318**	0.323**
	(2.25)	(2.27)	(2.09)	(2.10)
Sales	−0.105***	−0.102***	−0.582***	−0.581***
	(−8.10)	(−7.82)	(−6.95)	(−7.10)
PPE	−0.008	−0.007	−0.063	−0.063
	(−0.85)	(−0.75)	(−1.40)	(−1.40)
TobinQ	0.190***	0.190***	0.638***	0.632***
	(10.26)	(10.14)	(7.90)	(7.80)
ROA	−1.405***	−1.419***	−4.265***	−4.283***
	(−8.01)	(−8.07)	(−5.96)	(−6.04)
Lev	1.021***	1.028***	2.442***	2.425***
	(13.15)	(13.20)	(3.94)	(3.92)
Cash	1.267***	1.325***	1.172	1.103
	(6.23)	(6.47)	(1.17)	(1.11)
Rf		−0.185		−0.538
		(−1.13)		(−0.47)
ΔVkospi		−0.002***		−0.001
		(−4.19)		(−0.50)
EPU		−0.002		−0.022
		(−0.84)		(−1.32)
Intercept	−0.688***	−0.499*	8.185***	8.399***
	(−2.68)	(−1.90)	(5.63)	(5.72)
N	49,694	49,694	49,694	49,694
LR	668.58***	690.15***	687.26***	762.76***
Firm	Yes	Yes	Yes	Yes
R^2	0.0586	0.0605	0.1950	0.1968

Notes: This table examines whether market sentiment influences stock issuance. The columns labeled *Probit* present the results from probit regressions, using the likelihood of equity issuance as the dependent variable. The columns labeled *PPML* present the results from PPML regressions, using the incremental market value following the SEOs as the dependent variable. *ΔMktSent* denotes the change in market sentiment. *DConstrained* is a dummy variable that equals one if firms are in the top tertile of the SA index. *ΔMktSent*×*DConstrained* denotes the interaction between *ΔMktSent* and *DConstrained*. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *Rf*, *ΔVkospi*, and *EPU* denote the risk-free rate, the change in implied volatility, and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *LR* and R^2 represent the likelihood ratio statistic and pseudo *R*-squared values, respectively. *Firm* indicates whether firm-fixed effects are included in the models. Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

We find that the estimated coefficients of *DConstrained* are significantly positive, indicating that financially constrained firms are more likely to issue stocks for funding. The coefficients of *ΔMktSent*×*DConstrained* are also significantly positive, showing a greater tendency to issue stocks as market sentiment becomes more optimistic. Specifically, the estimated coefficient of *ΔMktSent*×*DConstrained* in Model M2 is 0.063, and the calculated marginal effect is 0.0034. This result indicates that a one standard deviation increase in *ΔMktSent* is associated with a 0.34 percentage point increase in the probability of issuing new shares among financially constrained firms. Given the baseline probability of stock issuance is 2.7%, this represents a relative increase of approximately 12.5%. For the magnitude of financing, the coefficient of *ΔMktSent*×*DConstrained* in Model M4 is 0.323, suggesting that an increase in market sentiment by one standard deviation leads to an approximately 10.32% increase in the expected incremental market value following SEOs. Considering the mean and standard deviation of the incremental market value (41.34% and 21.56%, respectively), this effect is economically significant. Overall, our findings suggest that when market sentiment is optimistic, financially constrained firms are more likely to raise external capital through equity issuance, both more frequently and at a larger scale.

We investigate whether the funds raised through equity issuance are subsequently invested in innovation. Firm managers typically decide on the innovation projects at the beginning of the fiscal year and subsequently secure the necessary capital through SEOs. Because there is an inherent time lag between capital raising and its actual investment in innovation, this study focuses exclusively on SEO events that occurred in the first half of the fiscal year.[3] There are two proxies for stock issuance in year *y*. *DIssuance* denotes the indicator variable that equals one if firms increase stock issuance. *RIssuance* denotes the incremental market value following SEOs scaled by total assets at the end of the fiscal year. Table 5 shows the results on the relationship between stock issuance and innovation

[3] Even when considering the SEO events occurring from the first to the third quarter, the results remain consistent with Table 5.

Table 5
Mechanism test of the financing channel.

	Constrained				Unconstrained			
	Panel		PPML		Panel		PPML	
	M1	M2	M3	M4	M5	M6	M7	M8
DIssuance	0.419**		0.388***		0.027		0.005	
	(2.37)		(2.75)		(0.21)		(0.04)	
RIssuance		0.005*		0.004**		−0.000		0.000
		(1.71)		(2.33)		(−0.13)		(0.33)
Sales	−0.058	0.080*	−0.102	0.156*	−0.073	0.297***	−0.123	0.340***
	(−0.47)	(1.88)	(−0.78)	(1.83)	(−0.88)	(3.41)	(−1.36)	(2.87)
PPE	−0.154***	−0.043	−0.250***	−0.130*	−0.068	0.013	−0.104	0.006
	(−3.35)	(−1.47)	(−3.65)	(−1.84)	(−1.20)	(0.29)	(−1.38)	(0.14)
TobinQ	0.054	0.050	−0.045	0.046	0.295*	0.219**	0.147	0.170*
	(0.32)	(1.12)	(−0.33)	(1.05)	(1.66)	(2.10)	(1.21)	(1.91)
ROA	−0.808	−0.571	−0.493	−0.812**	−1.288*	−0.647*	−1.218*	−0.730*
	(−0.70)	(−1.58)	(−0.46)	(−1.97)	(−1.81)	(−1.88)	(−1.78)	(−1.69)
Lev	−0.114	−0.440	0.061	−0.356	−0.466	0.278	−0.331	0.337
	(−0.24)	(−1.43)	(0.13)	(−1.30)	(−1.34)	(0.77)	(−0.86)	(0.93)
Cash	2.782	−0.536	2.706	−0.597	0.376	0.589	0.512	0.415
	(1.44)	(−0.93)	(1.59)	(−1.07)	(0.44)	(1.27)	(0.59)	(0.93)
GDP	5.723	−0.590	8.195*	−0.287	−5.324	9.043***	−4.147	9.988***
	(1.35)	(−0.30)	(1.77)	(−0.13)	(−1.09)	(2.87)	(−0.75)	(2.93)
EPU	−0.120	−0.051	−0.140	−0.056	−0.005	0.299***	−0.001	0.294**
	(−0.77)	(−0.58)	(−0.82)	(−0.61)	(−0.03)	(2.62)	(−0.01)	(2.26)
Intercept	−2.999	0.364	−3.647**	−0.163	−2.747	−2.976	−4.420	−4.050
	(−1.51)	(0.24)	(−2.01)	(−0.09)	(−1.02)	(−1.46)	(−1.52)	(−1.45)
N	2111	2098	2111	2067	1991	1979	1991	1931
FE	Industry	Firm	Industry	Firm	Industry	Firm	Industry	Firm
R^2	0.113	0.013	0.202	0.538	0.081	0.054	0.084	0.446

Notes. This table shows whether stock issuance plays a role as a financing channel in the relationship between market sentiment and innovation investment. Firms in the top (bottom) tertile of the SA index are classified as *Constrained* (*Unconstrained*). The columns labeled *Panel* (*PPML*) indicate the results using panel (PPML) regressions. *DIssuance* indicates the dummy variable and equals one if firms increase stock issuance. *RIssuance* indicates the incremental market value following SEOs. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *FE* indicates whether industry- or firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

investment. In the *Constrained* columns, the coefficients of *DIssuance* and *RIssuance* are significantly positive, while those in the *Unconstrained* columns are insignificant. These findings imply that financially constrained firms raise capital through equity financing and subsequently invest in innovation. Given the positive relationship between market sentiment and stock issuance for financially constrained firms, the results suggest that such firms are more likely to deploy newly raised equity funds into innovation when market sentiment becomes optimistic.

During the COVID-19 pandemic, a major exogenous shock, Trunschke et al. (2024) argue that firms reduce R&D investment, a representative long-term investment, to enhance short-term profitability. Chung et al. (2023) find that financially constrained firms tend to decrease investment and increase cash holdings. The average value of *ΔMktSent* declines sharply from 0.018 before the pandemic to −0.029 during the pandemic, indicating that investor sentiment turns negative in response to the exogenous shock, consistent with Seok et al. (2024b). The relationship between market sentiment and innovation investment may vary because of changes in firms' investment environment and overall market sentiment. Although financially unconstrained firms are generally expected to be less sensitive to market sentiment, as shown in Table 3, under heightened overall market uncertainty, such as COVID-19, these firms may adjust R&D investment in response to market sentiment.

Table 6 examines whether the effect of market sentiment on innovation investment varies by financial constraints and during the COVID-19 period. *DCovid* is a dummy variable equal to one for the period from January 2020 to December 2023. *ΔMktSent*×*DCovid* represents the interaction between *ΔMktSent* and *DCovid*. In the *Constrained* columns, the coefficient for *ΔMktSent* is significantly positive, while the interaction term is not significant. These findings indicate that market sentiment's role in R&D decisions for financially constrained firms does not change with increased market uncertainty. In contrast, in the *Unconstrained* columns, the coefficient for *ΔMktSent* is not significant, but the interaction term is significantly positive. Dash and Maitra (2022) show that pessimistic sentiment driven by pandemic-related uncertainty increases market volatility and illiquidity. During the pandemic, raising capital becomes more difficult, so even relatively financially unconstrained firm managers encounter financial restrictions. Therefore, we suggest that investor sentiment has a particularly amplified effect under heightened uncertainty.

In the Korean market, the presence of chaebols introduces significant heterogeneity in firms' responses to market sentiment regarding innovation investment decisions. Chaebol-affiliated firms differ from non-chaebol firms in organizational structure,

Table 6
Impact of market sentiment across financial constraints and the COVID period.

	Constrained		Unconstrained	
	Panel	PPML	Panel	PPML
ΔMktSent	0.048*	0.051**	0.028	0.046
	(2.06)	(2.10)	(0.29)	(0.34)
ΔMktSent × DCovid	−0.029	−0.047	0.104	0.073
	(−0.70)	(−0.86)	(1.18)	(0.55)
Sales	0.072	0.148	0.240**	0.277***
	(1.28)	(1.31)	(3.02)	(2.80)
PPE	−0.040	−0.123	−0.001	−0.012
	(−1.33)	(−1.61)	(−0.02)	(−0.23)
TobinQ	0.040	0.034	0.124	0.092*
	(0.85)	(0.71)	(1.70)	(1.77)
ROA	−0.632*	−0.879**	−0.627	−0.688
	(−2.02)	(−2.28)	(−1.65)	(−1.40)
Lev	−0.411	−0.339	0.429	0.399
	(−1.52)	(−1.37)	(1.35)	(1.24)
Cash	−0.501	−0.535	0.467	0.313
	(−0.89)	(−0.93)	(1.09)	(0.83)
GDPVolat	−0.371	−0.129	6.562**	8.083**
	(−0.25)	(−0.09)	(2.21)	(2.26)
EPU	−0.001	0.021	0.032	0.041
	(−0.01)	(0.27)	(0.36)	(0.33)
Intercept	0.072	−0.693	−4.082**	−4.876***
	(0.07)	(−0.34)	(−2.82)	(−2.72)
N	2098	2067	1979	1931
Firm	Yes	Yes	Yes	Yes
R^2	0.0130	0.5379	0.0558	0.4457

Notes. This table presents the impact of market sentiment on R&D investment decisions across financial constraints and the COVID period. Firms in the top (bottom) tertile of the SA index are classified as *Constrained* (*Unconstrained*). The columns labeled *Panel* (*PPML*) indicate the results using panel (PPML) regressions. *ΔMktSent* denotes the change in market sentiment. *ΔMktSent*×*DCovid* indicates the interaction term between *ΔMktSent* and *DCovid*. *DCovid* is a dummy variable that equals one for the period from Jan. 2020 to Dec. 2023. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm and year levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

financial capacity, and access to external resources, indicating that market sentiment may affect their investment behavior differently. Chaebol-affiliated firms typically have stronger financial bases and long-term strategic orientations compared to non-chaebol firms. The Korea Fair Trade Commission annually announces the top 30 business groups and their affiliates. Using this classification, we identify 148 chaebol-affiliated firms in 572 firms, representing approximately 25.9% of the sample. This proportion enables a meaningful comparison between chaebol-affiliated and non-chaebol firms. To examine these differences, we define *DChaebol* as a dummy variable equal to one if a firm belongs to one of the top 30 business groups in a given year. A significant coefficient for the interaction term between *ΔMktSent* and *DChaebol* indicates that market sentiment affects chaebol and non-chaebol firms differently in their innovation investment decisions.

Table 7 presents the results on the effect of market sentiment across financial constraints and chaebol affiliation. The coefficient of the interaction term is not significant in the *Unconstrained* columns but is significantly positive in the *Constrained* columns. This result indicates that financially constrained, chaebol-affiliated firms are more likely to adjust R&D investment in response to market sentiment. Consistent with Lee et al. (2024), our findings suggest that chaebol-affiliated firms show a stronger commitment to R&D investment for long-term growth. In our sample, the average R&D investment ratio does not differ significantly between financially unconstrained firms with and without chaebol affiliation; however, among financially constrained firms, chaebol-affiliated firms invest significantly more in R&D. These results imply that financially constrained, chaebol-affiliated firms use market sentiment as an important channel to overcome financing constraints, thereby strengthening their ability to sustain innovation investment, despite adverse conditions.

4.2. Managerial sentiment channel

Managerial characteristics affect key decisions regarding firms' operations, such as investment and M&A (mergers and acquisitions). Phua et al. (2018) find that overconfident managers often overestimate their firms' potential and underestimate idiosyncratic risks. Higher levels of managerial overconfidence are associated with increased innovation investment, reflecting greater risk tolerance (Galasso and Simcoe, 2011; Hirshleifer et al., 2012). Managerial overconfidence is also positively associated with market sentiment

Table 7
Impact of market sentiment across financial constraints and chaebol affiliation.

	Constrained		Unconstrained	
	Panel	PPML	Panel	PPML
ΔMktSent	0.012	0.008	0.054	0.067
	(0.75)	(0.35)	(0.95)	(1.04)
ΔMktSent × DChaebol	0.063**	0.069**	0.440	0.901
	(2.34)	(2.14)	(0.70)	(0.68)
Sales	0.066	0.129	0.256***	0.294***
	(1.17)	(1.17)	(3.25)	(2.87)
PPE	−0.042	−0.128*	0.006	−0.001
	(−1.42)	(−1.70)	(0.12)	(−0.02)
TobinQ	0.045	0.040	0.127	0.099*
	(1.00)	(0.87)	(1.75)	(1.90)
ROA	−0.598*	−0.816**	−0.674	−0.776
	(−1.94)	(−2.09)	(−1.73)	(−1.55)
Lev	−0.399	−0.303	0.422	0.433
	(−1.48)	(−1.22)	(1.35)	(1.35)
Cash	−0.540	−0.590	0.537	0.366
	(−0.97)	(−1.03)	(1.22)	(0.94)
GDPVolat	−0.588	−0.314	7.629*	9.275**
	(−0.32)	(−0.14)	(2.12)	(2.11)
EPU	−0.052	−0.054	0.236*	0.238**
	(−0.63)	(−0.59)	(2.17)	(1.97)
Intercept	0.273	−0.153	−4.658***	−5.532***
	(0.25)	(−0.08)	(−3.30)	(−3.08)
N	2111	2079	1992	1940
Firm	Yes	Yes	Yes	Yes
R^2	0.0129	0.5398	0.0527	0.4458

Notes. This table presents the impact of market sentiment on R&D investment decisions across financial constraints and chaebol affiliation. Firms in the top (bottom) tertile of the SA index are classified as *Constrained* (*Unconstrained*). The columns labeled *Panel* (*PPML*) indicate the results using panel (PPML) regressions. *ΔMktSent* denotes the change in market sentiment. *ΔMktSent*×*DChaebol* indicates the interaction term between *ΔMktSent* and *DChaebol*. *DChaebol* is a dummy variable that equals one if a firm belongs to one of the top 30 business groups in a given year. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm and year levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

(Malmendier and Tate, 2015). When market sentiment is optimistic, managers may become even more overconfident. We expect that highly overconfident managers are more likely to increase innovation investment in optimistic market conditions.

As shown in Eq. (4), we examine whether managerial sentiment moderates the relationship between market sentiment and innovation investment. To assess the role of managerial sentiment, we use both panel data and PPML regressions as robustness checks. We measure managerial sentiment (*MngSent*) as the difference between expected and actual earnings per share. To address the highly positive skewness of this difference, we assign values of 1, −1, or 0 when the difference is greater than, less than, or equal to zero, respectively. When *MngSent* is greater than zero, we define managers as overconfident. If β_3 is significantly positive, we can interpret that overconfident managers increase innovation investment when market sentiment is more optimistic.

$$Innov_{i,y} = \beta_0 + \beta_1 \Delta MktSent_y + \beta_2 MngSent_{i,y} + \beta_3 \left(\Delta MktSent_y \times MngSent_{i,y} \right) + \gamma' X_{i,y-1} + \rho' \tau_y + \delta_i + \varepsilon_{i,y} \quad (4)$$

Table 8 presents the role of managerial sentiment in the relationship between market sentiment and innovation investment. The columns labeled *All*, *Constrained*, and *Unconstrained* report results for all firms, financially constrained firms, and financially unconstrained firms, respectively. The coefficient of the interaction term is insignificant in the *All* and *Unconstrained* columns but significantly positive in the *Constrained* column, indicating that market sentiment affects innovation investment through managerial overconfidence only among financially constrained firms. Because Table 3 shows that the effect of market sentiment is significant only for financially constrained firms, this finding is consistent and reasonable.

Moshirian et al. (2017) suggest that emerging countries continue to have a high proportion of traditional industries, such as manufacturing, whereas developed countries have shifted to R&D-intensive industries, reflected in low tangibility in developed markets and high tangibility in emerging markets. Although firms in emerging markets have gradually increased innovation investment because of technological advancements, their tangible asset ratios have declined only slowly. In this context, firms investing in R&D face greater financing needs, as they must secure funds for both innovation-related intangible investment and traditional physical investment. Supporting this, we find that the average tangible asset ratio in firms with R&D investment (4.11%) is similar to that in firms without R&D investment (3.67%), and the difference is not significant. Therefore, market sentiment may serve as an attractive financing source, especially for financially constrained firms engaged in R&D activities. We expect the effect of market sentiment on tangible asset investment decisions to be stronger for financially constrained firms that invest in R&D than for those that do not.

Table 8
Role of manager sentiment.

	All		Constrained		Unconstrained	
	Panel	PPML	Panel	PPML	Panel	PPML
ΔMktSent	0.041	0.052	0.036**	0.032	0.071	0.102
	(1.50)	(1.51)	(2.44)	(1.59)	(0.97)	(1.16)
MngSent	0.006	0.005	−0.012	−0.018	0.007	0.014
	(0.73)	(0.51)	(−1.18)	(−1.45)	(0.50)	(0.90)
ΔMktSent × MngSent	0.016	0.017	0.057*	0.070*	0.036	0.004
	(0.51)	(0.47)	(1.97)	(1.80)	(0.55)	(0.06)
Sales	0.155***	0.190***	0.066	0.133	0.236**	0.270**
	(3.39)	(3.42)	(1.16)	(1.19)	(2.72)	(2.45)
PPE	−0.041	−0.066	−0.042	−0.127*	0.023	0.016
	(−1.43)	(−1.50)	(−1.36)	(−1.65)	(0.53)	(0.37)
TobinQ	0.097*	0.078*	0.044	0.034	0.108	0.113*
	(1.82)	(1.79)	(0.96)	(0.74)	(1.27)	(1.65)
ROA	−0.651**	−0.734**	−0.612*	−0.857**	−0.786*	−0.849*
	(−2.54)	(−2.42)	(−1.97)	(−2.27)	(−1.98)	(−1.66)
Lev	−0.084	−0.011	−0.414	−0.301	0.211	0.253
	(−0.46)	(−0.06)	(−1.52)	(−1.20)	(0.64)	(0.74)
Cash	0.189	0.193	−0.548	−0.550	0.410	0.460
	(0.67)	(0.63)	(−0.94)	(−0.94)	(0.96)	(0.97)
GDPVolat	2.564*	3.380**	−0.602	−0.508	9.353**	10.731**
	(1.79)	(2.01)	(−0.34)	(−0.25)	(2.39)	(2.37)
EPU	0.074	0.056	−0.055	−0.065	0.256*	0.262*
	(1.16)	(0.77)	(−0.65)	(−0.72)	(1.98)	(1.84)
Intercept	−1.891*	−2.541**	0.286	−0.231	−4.391**	−5.303***
	(−2.14)	(−2.40)	(0.25)	(−0.12)	(−2.83)	(−2.62)
N	5643	5618	2054	2025	1644	1610
Firm	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0172	0.4904	0.0141	0.5348	0.0441	0.4320

Notes. This table shows that managerial sentiment influences the relationship between market sentiment and innovation investment. The columns labeled *All*, *Constrained*, and *Unconstrained* indicate the results using the sample including all firms, those in the top tertile of the SA index, and those in the bottom tertile of the SA index, respectively. The columns labeled *Panel* (*PPML*) present the results using panel (PPML) regression. *ΔMktSent* and *MngSent* denote the change in market sentiment and managerial sentiment, respectively. *ΔMktSent*×*MngSent* indicates the interaction between the change in market sentiment and managerial sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm and year levels. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

We examine whether physical investment differs between firms with and without R&D investment by employing the regressions, as presented in Eqs. (1) and (2), using the ratio of tangible assets as the dependent variable instead of the ratio of R&D investment. The ratio of tangible assets is scaled by total assets at the beginning of the fiscal year. Table 9 shows that the effect of market sentiment on tangible assets differs between firms with R&D investment and those without. The columns labeled *R&D* and *Non-R&D* report results for samples consisting exclusively of firms with and without R&D expenditure, respectively.

The coefficients of *ΔMktSent* are significantly positive only for financially constrained firms with R&D investment. These firms have difficulty securing financing for their investment and, therefore, rely on market sentiment to obtain funds. In contrast, the coefficients of *ΔMktSent* are not significant for firms without R&D investment. Regardless of financial constraint, these firms either do not require substantial capital investment or possess sufficient internal funds, making their investment decisions less sensitive to market sentiment. We suggest that market sentiment affects managerial physical investment decisions only in financially constrained firms with R&D investment.

We further examine whether managerial decisions differ between intangible and tangible investments. Because innovation investment, classified as intangible assets, has lower collateral value, managers are generally more reluctant to increase innovation investment than physical investment, which consists of tangible assets such as plant, property, and equipment and has higher collateral value. We expect managerial sentiment to have a greater influence on R&D investment decisions. Overconfident managers strongly believe that the firm will grow through R&D investment and, therefore, do not hesitate to increase innovation investment. To examine whether managerial sentiment moderates the relationship between market sentiment and investment decisions, we use the regressions shown in Eq. (4), substituting the ratio of tangible assets to total assets as the dependent variable instead of the ratio of R&D investment.

Table 10 shows whether managerial sentiment affects the relationship between market sentiment and tangible assets for firms with R&D investment. The coefficient for *ΔMktSent* remains significantly positive, indicating that managers increase physical investment when market sentiment is optimistic. However, the interaction term between *ΔMktSent* and *MngSent* is not significant, regardless of financial constraint. This result suggests that, although managers consider market sentiment, they do not depend on their own

Table 9
Impact of market sentiment on capital expenditure.

	R&D				No R&D			
	Constrained		Unconstrained		Constrained		Unconstrained	
	Panel	PPML	Panel	PPML	Panel	PPML	Panel	PPML
ΔMktSent	0.452***	0.119***	−0.157	−0.055	0.335	0.083	0.365	0.142
	(3.01)	(3.45)	(−0.74)	(−0.85)	(1.25)	(1.22)	(0.77)	(0.80)
Sales	0.043	0.009	0.041	0.003	−0.161	−0.149	0.918**	0.367**
	(0.15)	(0.13)	(0.18)	(0.04)	(−0.28)	(−1.36)	(2.00)	(2.10)
PPE	0.230*	0.055	−0.023	−0.015	0.131	0.074	0.153	0.076
	(1.77)	(1.61)	(−0.13)	(−0.25)	(0.45)	(0.63)	(0.72)	(0.68)
TobinQ	1.870***	0.288***	0.380*	0.076	2.065**	0.345***	1.115	0.316
	(6.36)	(7.44)	(1.91)	(1.32)	(2.16)	(2.93)	(1.58)	(1.54)
ROA	12.304***	3.569***	5.332***	2.064***	3.902	1.299	−1.010	−0.482
	(5.19)	(6.83)	(3.23)	(3.60)	(0.76)	(1.59)	(−0.13)	(−0.19)
Lev	0.918	0.492*	−2.120**	−0.592*	−7.651	−1.377	−3.416**	−1.407**
	(0.74)	(1.78)	(−2.01)	(−1.75)	(−1.09)	(−1.43)	(−2.22)	(−2.20)
Cash	3.504*	0.635	6.339***	2.269***	1.407	0.463	1.457	0.762
	(1.93)	(1.57)	(3.01)	(3.39)	(0.36)	(0.64)	(0.58)	(0.58)
GDPVolat	−19.161**	−5.818**	−12.655	−3.178	−26.789	−7.682	−18.085	−8.623
	(−1.99)	(−2.30)	(−0.86)	(−0.71)	(−0.85)	(−1.08)	(−0.80)	(−0.89)
EPU	−0.721**	−0.204**	−0.093	0.028	−0.269	−0.041	−1.490**	−0.672**
	(−1.99)	(−2.38)	(−0.18)	(0.18)	(−0.39)	(−0.23)	(−2.22)	(−2.48)
Intercept	−2.231	0.183	2.962	1.531	8.114	4.179	−14.529	−5.574
	(−0.37)	(0.13)	(0.73)	(1.26)	(0.71)	(1.47)	(−1.59)	(−1.63)
N	2129	2129	1989	1989	712	712	684	678
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1325	0.3551	0.0344	0.2748	0.0748	0.3283	0.0324	0.2923

Notes. This table shows that market sentiment influences capital expenditure. The columns labeled *R&D* (*No R&D*) indicate the results using the sample including firms with (without) R&D expenditure. The columns labeled *Constrained* and *Unconstrained* indicate the results using the sample, including firms in the top and bottom tertiles of the SA index, respectively. The columns labeled *Panel* (*PPML*) present the results using panel (PPML) regression. *ΔMktSent* denotes the change in market sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

sentiment when making physical investment decisions. In contrast to the results in Table 8, managers appear to rely more on their managerial sentiment for innovation investment decisions, likely because such decisions require strong confidence that R&D investment will succeed.

5. Robustness checks

5.1. Industry effect

Individual firms' R&D investment decisions are substantially influenced by industry-specific conditions. Firms may increase R&D investment for strategic reasons and in response to technological developments within their industries. To account for unobserved industry characteristics, we include industry fixed effects in the model (Alam et al., 2019; Chan et al., 2015). Table 11 reports the results controlling for industry fixed effects. Models *M1* and *M4* include only industry fixed effects, while Models *M2* and *M5* include both industry and firm-fixed effects. Model *M3* incorporates interactive fixed effects between firm and industry. The results show that the coefficient of *ΔMktSent* remains significantly positive after controlling for industry heterogeneity. Notably, the estimated coefficient of *ΔMktSent* (0.074) in Model *M3* is more statistically significant than the corresponding estimate in Model *M2* of Table 2. These findings confirm that the positive effect of market sentiment on R&D investment is robust when accounting for industry-level heterogeneity.

5.2. Sample selection bias

Excluding firms with no R&D investment from the sample may introduce selection bias and truncation issues. Firms that report no R&D expenditure are not randomly distributed; they may systematically differ from those with positive R&D investment regarding financial stability, risk attitudes, or industry characteristics. Omitting these firms can lead to biased and inconsistent estimates because the remaining sample does not represent the full distribution of firms' innovation decisions.

To address this concern, we examine the two-stage Heckman correction model, which explicitly accounts for the non-random selection of firms into the R&D investment group. By modeling both the decision to invest in R&D and the intensity of investment

Table 10
Managerial sentiment, market sentiment, and capital expenditure.

	Constrained		Unconstrained	
	Panel	PPML	Panel	PPML
ΔMktSent	0.461***	0.121***	−0.040	−0.031
	(3.01)	(3.45)	(−0.17)	(−0.42)
MngSent	−0.023	−0.007	−0.065	−0.023
	(−0.34)	(−0.41)	(−0.64)	(−0.72)
ΔMktSent × MngSent	0.091	0.001	−0.348	−0.126
	(0.44)	(0.02)	(−1.11)	(−1.31)
Sales	0.031	0.003	0.220	0.065
	(0.11)	(0.04)	(0.88)	(0.77)
PPE	0.247*	0.059*	−0.100	−0.047
	(1.87)	(1.71)	(−0.62)	(−0.78)
TobinQ	1.931***	0.294***	0.459*	0.099
	(6.68)	(6.90)	(1.97)	(1.54)
ROA	12.350***	3.606***	5.796***	2.276***
	(5.19)	(6.90)	(3.07)	(3.55)
Lev	0.815	0.488*	−1.697	−0.479
	(0.66)	(1.76)	(−1.50)	(−1.27)
Cash	3.262*	0.582	4.248**	1.726**
	(1.80)	(1.41)	(2.01)	(2.36)
GDPVolat	−18.585*	−5.704**	−10.825	−2.989
	(−1.89)	(−2.21)	(−0.68)	(−0.58)
EPU	−0.741**	−0.212**	0.127	0.092
	(−2.07)	(−2.48)	(0.24)	(0.55)
Intercept	−2.168	0.268	0.027	0.593
	(−0.35)	(0.19)	(0.01)	(0.42)
N	2083	2083	1647	1647
Firm	Yes	Yes	Yes	Yes
R^2	0.1404	0.3584	0.0352	0.2598

Notes. This table indicates that managerial sentiment influences the relationship between market sentiment and capital expenditure. The columns labeled *Constrained* and *Unconstrained* indicate the results using the sample, including firms in the top and bottom tertiles of the SA index, respectively. The columns labeled *Panel* (*PPML*) present the results using panel (PPML) regression. *ΔMktSent* and *MngSent* denote the change in market sentiment and managerial sentiment. *ΔMktSent*×*MngSent* indicates the interaction between the change in market sentiment and managerial sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *N* indicates the number of observations. *Firm* indicates whether firm-fixed effects are included in the models. R^2 reports the within (pseudo) *R*-squared values in the columns labeled *Panel* (*PPML*). Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

conditional on participation, the Heckman procedure corrects for potential selection bias. Applying this framework ensures that the estimated effect of market sentiment on R&D investment reflects the underlying relationship across the broader firm population, rather than being driven by sample truncation.

Table 12 presents the results of the two-stage Heckman correction analysis. Columns M1 and M2 report models with and without firm-fixed effects, respectively. The columns labeled *First* display the selection model, with the likelihood of R&D investment as the dependent variable. The columns labeled *Second* show the effect of market sentiment on the intensity of R&D investment. The coefficient of *ΔMktSent* is significantly positive, indicating that market sentiment affects R&D investment decisions after accounting for sample selection bias. Additionally, the insignificant Mills' λ suggests no serious selection bias.

6. Conclusion and policy implications

This study examines the role of investor sentiment in influencing firms' innovation investment in an emerging market context. We find that market sentiment positively affects innovation investment, particularly among financially constrained firms. Within this group, chaebol-affiliated firms are more responsive to market sentiment when making innovation investment decisions. Financially constrained firms are consistently affected by market sentiment, whereas financially unconstrained firms are influenced by market sentiment only during periods of market uncertainty. Market sentiment also affects physical investment, but this effect is limited to firms actively engaged in R&D, indicating that firms undergoing industrial transformation must finance both intangible and tangible assets at the same time. Furthermore, managerial sentiment amplifies the effect of market sentiment on innovation investment, highlighting the behavioral dimension of long-term, high-risk strategic choices. In contrast, managerial confidence does not significantly affect physical investment. These findings highlight investor sentiment as an important, nontraditional financing channel in settings with underdeveloped financial systems, providing essential support to financially constrained firms in emerging markets.

These results make two key contributions. First, we show that sentiment-driven equity financing can help reduce innovation financing constraints in emerging economies, where traditional financial intermediation is often underdeveloped. Second, this study provides evidence that the impact of sentiment varies both across investment types and across sentiment sources. Market sentiment has

Table 11
Controlling for the industry-fixed effect.

	Panel		Interactive	PPML	
	M1	M2	M3	M4	M5
ΔMktSent	0.101***	0.038*	0.074***	0.113***	0.050*
	(3.95)	(1.66)	(3.81)	(3.97)	(1.92)
Sales	0.119***	0.163***	−0.019	0.141***	0.203***
	(2.63)	(5.19)	(−0.72)	(3.19)	(5.80)
PPE	−0.122***	−0.048***	−0.010	−0.190***	−0.075***
	(−4.04)	(−2.78)	(−0.47)	(−4.56)	(−3.25)
TobinQ	0.500***	0.103***	0.175**	0.377***	0.078***
	(5.42)	(2.71)	(2.23)	(6.91)	(2.76)
ROA	−1.094*	−0.603***	−0.542*	−1.033*	−0.711***
	(−1.90)	(−2.84)	(−1.68)	(−1.82)	(−3.13)
Lev	−0.772***	0.007	−0.439*	−0.742***	0.069
	(−3.04)	(0.05)	(−1.80)	(−2.73)	(0.50)
Cash	1.161	0.238	0.557	1.210	0.195
	(1.55)	(1.14)	(1.05)	(1.59)	(0.97)
GDPVolat	2.393	2.278	2.223	4.166	3.113*
	(1.06)	(1.54)	(1.17)	(1.58)	(1.94)
EPU	0.067	0.078*	0.107	0.098	0.062
	(0.77)	(1.89)	(1.47)	(1.02)	(1.33)
Intercept	−0.290	−2.033***	0.876	−0.809	−2.714***
	(−0.40)	(−3.47)	(1.39)	(−1.10)	(−4.14)
N	6192	6192	6192	6192	6117
Firm	No	Yes	No	No	Yes
Industry	Yes	Yes	No	Yes	Yes
Firm × Industry	No	No	Yes	No	No
SE	Firm	Robust	Firm	Firm	Robust
R^2	0.0797	0.0199	0.2002	0.1091	0.4934

Notes. This table reports that market sentiment influences innovation investment, even after controlling for industry fixed effects. The columns labeled *Panel*, *Interactive*, and *PPML* present the results from panel regressions, interactive fixed-effect regressions, and PPML regressions, respectively. *ΔMktSent* denotes the change in market sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, the ratio of debt-to-total assets, and cash-to-total assets, respectively. *GDPVolat* and *EPU* denote GDP growth volatility and economic policy uncertainty, respectively. *Intercept* refers to the constant term. *N* indicates the number of observations. *Firm*, *Industry*, and *Firm×Industry* indicate whether firm-fixed, industry-fixed, and firm-industry-interaction-fixed effects are included in the models, respectively. *SE* specifies whether robust standard errors (*Robust*) or firm-clustered standard errors (*Firm*) are reported. R^2 reports within *R*-squared values in the *Panel* columns and pseudo *R*-squared values in the *Interactive* and *PPML* columns. Figures in parentheses are *t*-statistics. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

a stronger effect on innovation than on physical capital, and investor versus managerial sentiments could differentially shape firm behavior.

Our findings offer several important implications for understanding the role of sentiment-driven financing in promoting corporate innovation investment. Our results show that optimistic market sentiment facilitates a firm's external financing and subsequently enhances its innovation investment. This suggests that sentiment-driven financing can function as an alternative channel supporting innovation, particularly in environments where traditional financing is limited. In emerging markets where retail investors' participation is high and market sentiment exerts a stronger influence on financing activities, understanding how behavioral factors influence capital flows is essential for explaining the dynamics of innovation financing.

The effect of sentiment-driven financing is especially pronounced among financially constrained firms. These firms often face difficulties in raising funds for long-term, innovation-oriented projects despite having strong growth opportunities. This implication is particularly relevant for firms in emerging markets such as Korea, where financing constraints are pervasive, but sustained innovation investment is necessary for long-term growth and competitiveness. Sentiment-driven financing can therefore alleviate financing frictions by allowing such firms to access external equity capital when market sentiment becomes optimistic. Interestingly, the average ratios of innovation investment of financially constrained and unconstrained firms do not differ significantly in our sample. When investor optimism improves, sentiment-driven financing provides an additional avenue through which constrained firms can sustain or expand their innovation activities. It also helps activate domestic financial markets and increase market participation by enabling firms to raise innovation-oriented capital through public markets.

Nevertheless, the broader consequences of sentiment-driven financing remain uncertain. While sentiment-driven capital flows appear to promote innovation investment, they may also introduce market volatility or lead to temporary mispricing if investor optimism becomes excessive. Future research could explore the long-term effects of sentiment-driven financing on firm value, investment efficiency, and market stability to better assess its overall economic implications.

CRediT authorship contribution statement

Karam Kim: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project

Table 12
Two-stage Heckman correction model.

	M1		M2	
	First	Second	First	Second
ΔMktSent		**0.132****		**0.055****
		(2.13)		**(3.02)**
Sales	0.094***	−0.216	0.094***	−0.043
	(9.04)	(−0.14)	(3.10)	(−0.25)
PPE	0.045***	−0.163**	0.045	−0.195**
	(4.67)	(−2.07)	(1.64)	(−2.35)
TobinQ	0.188***	0.315	0.188***	−0.247
	(6.81)	(0.99)	(2.78)	(−0.80)
ROA	−0.856***	−0.128	−0.856*	1.159
	(−3.25)	(−0.08)	(−1.84)	(0.71)
Lev	−0.188**	−0.775**	−0.188	0.268
	(−2.22)	(−2.28)	(−0.81)	(0.65)
Cash	0.377	1.241	0.377	−0.327
	(1.54)	(1.56)	(0.65)	(−0.44)
GDPVolat	−4.480	6.753	−4.480***	10.833
	(−1.61)	(0.75)	(−2.70)	(1.22)
EPU	−0.070	0.143	−0.070	0.262
	(−0.96)	(0.82)	(−1.14)	(1.63)
Intercept	−2.203***	4.477	−2.203***	06.351
	(−10.59)	(0.73)	(−3.82)	(0.99)
Mills λ		−1.899		−3.540
		(−0.62)		(−1.09)
N	8321	8321	8321	8321
Selected N	–	5052	–	5052
SE	Heckman	Heckman	Firm	Firm
Chi^2	187.68***	300.50***	26.18***	34.35***
R^2	0.017		0.017	

Notes. This table shows the results using the two-stage Heckman correction model. The columns labeled *First* (*Second*) show the results using the first-stage Tobit (second-stage panel) regression. *ΔMktSent* denotes the change in market sentiment. *Sales*, *PPE*, *TobinQ*, *ROA*, *Lev*, and *Cash* represent the logarithm of total sales, the logarithm of tangible assets scaled by the number of employees, Tobin's Q, return on assets, debt-to-total assets ratio, and cash-to-total assets ratio, respectively. *GDPVolat* and *EPU* indicate the volatility of GDP growth and economic policy uncertainty, respectively. *Intercept* denotes the intercept. *Mills λ* is the correction term derived from the first-stage selection model. *N* (*Selected N*) indicates the number (selected number) of observations. *SE* indicates whether standard errors are Heckman-corrected (*Heckman*) or clustered at the firm level (*Firm*). Chi^2 indicates the Wald chi-squared statistics. R^2 reports the pseudo *R*-squared values. Figures in parentheses are *t*-statistics. Standard errors are clustered at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jonathan A. Batten:** Conceptualization, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Doojin Ryu:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

There is no conflict of interest.

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Data availability

Data will be made available on request.

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