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Full Length Article

How does corporate social responsibility affect the cost of equity capital through operating risk?

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Abstract

This paper investigates the impact of corporate social responsibility (CSR) performance by listed companies on the cost of equity capital from the perspectives of enterprise risk management and capital market risk pricing and discusses the mediating effects of operating risk. Using the causal steps approach, we conduct an empirical test with a sample of 7241 Chinese A-share listed companies from 2013 to 2018. This paper uses the price-earnings-growth (PEG) model and the Ohlson-Juettner (OJ) model to calculate the cost of equity capital and accounting earnings volatility to measure operating risk. Our results lead to the following conclusions: First, CSR performance is significantly negatively correlated with the cost of equity capital; second, CSR performance is significantly negatively correlated with operating risk; third, operating risk is a mediating variable between CSR performance and the cost of equity capital, and the mediating effect differs between long- and short-term risks. Our conclusions are confirmed by robustness tests.
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Keywords: Corporate social responsibility; Cost of equity capital; Mediating effect; Operating risk

1. Introduction

Corporate social responsibility (CSR) has become an important management concern at global companies and has been implemented widely in emerging markets such as China (t Vermander, 2014). A high correlation is found between CSR performance and company financing costs (Attig, Ghoul, Guedhami, & Suh, 2013; Baker, Bergstresser, Serafeim, & Wurgler, 2018; Goss & Roberts, 2011; Weber, 2018; Ye & Zhang, 2011), but many disputes have been raised about the impact of CSR performance on the cost of equity capital. Some authors find a negative correlation between CSR performance and the cost of equity capital, that is, CSR is an important risk-pricing factor in the capital market (El Ghoul, Guedhami, Kwok, & Mishra, 2011). Jo and Harjoto (2015) illustrate that CSR can reduce information asymmetry, market risk, and transaction costs, and, in turn, the cost of equity capital. Moreover, Girerd-Potin, Jimenez-Garcès, and Louvet (2014) find that investors require additional risk compensation when investing in companies with poor CSR performance. Some studies using a sample of Chinese listed companies also see evidence of a negative correlation. Xu, Liu, and Huang (2015) conclude that the CSR at listed companies can reduce the cost of equity capital, and this effect is more obvious during an economic downturn. Chang, Hsieh, Wang, and Hsieh (2014) confirm that CSR activities can reduce the financing cost of bank credit and the equity market in Taiwan. Others, however, perceive a complex relation between CSR and the cost of equity capital and believe that a negative correlation is established only under certain conditions. Breuer, Müller, Rosenbach, and Salzmann (2018) reveal that the effect of CSR on cost reduction is limited to countries with relatively complete investor protection, however, the opposite is the case in other countries. Matthiesen and Salzmann (2017)

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find that the relation between CSR and the cost of equity capital is stronger in countries with lower levels of assertiveness and higher levels of humane orientation and institutional collectivism. Moreover, Feng, Wang, and Huang (2015) state that good CSR performance can reduce costs in North American and European countries, but not Asian countries.

The absence of consensus shows that further exploration of the correlation between CSR performance and cost of equity capital is needed, requiring analysis of the impact mechanism between them. However, few studies have been conducted on the channel through which CSR performance affects the cost of equity. Considering that the cost of equity is closely related to the company's risk level (Botosan & Plumlee, 2011; Fu, 2009; Merton, 1987; Taylor & Verrecchia, 2015), we hypothesize that operating risk might play a mediating role between CSR and the cost of equity capital. To test this hypothesis, we use a sample of Chinese A-share listed companies from 2013 to 2018 to study whether CSR performance can significantly reduce the cost of equity capital, with operating risk as a mediating variable.

2. Data and methodology

2.1. Hypothesis

CSR can reduce a company's risk in many ways, which has been widely proven. Albuquerque, Durnev, and Koskinen (2013) point out that CSR investment by companies can reduce systemic risk and increase firm value by widening product differentiation. Based on the stakeholder and resource-based theories, Luo and Bhattacharya (2009), Bouslah, Kryzanowski, and M'zali (2013), and Chollet and Sandwidi (2018) confirmed the role of CSR in reducing both idiosyncratic and systemic risks. Some scholars also find that engaging in CSR activities improves trust with stakeholders and reduces firm risk. For example, CSR activities can enhance product pricing ability by improving customer satisfaction and loyalty and then reducing the risk of earnings fluctuation (Ailawadi, Neslin, Luan, & Taylor, 2014; Galbreath & Shum, 2012; Sen & Bhattacharya, 2001); by reducing reputational risk via mitigating public information asymmetry and creating favorable public opinion (Cui, Jo, & Na, 2018); by improving productivity through employee incentives (Aguilera, Rupp, Williams, & Ganapathi, 2007), while avoiding litigation risks caused by transgressions of employee rights (Flammer & Luo, 2017); by obtaining suppliers' trade credit support, thereby increasing stability in the supply chain and improving operating conditions (Yawar & Seuring, 2017; Zhang, Ma, Su, & Zhang, 2014); and by obtaining investor preferences to receive higher market transaction volume and asset prices, which ultimately lead to a reduction in investment risk (Cox & Wicks, 2011).

El Ghoul et al. (2011) argue that companies with poor CSR performance have higher perceived risk, leading investors to seek compensation for it. This means that CSR can affect the company's cost of equity capital by affecting operating risk, that is, operating risk plays an intermediary role. Moreover, operating risk can be divided into long-term risks and short-term risks: some factors may influence long-term business operations, such as consumer loyalty, reputation, and supplier relationships; however, other factors affect short-term performance, such as employee incentives, litigation risk, and investor preferences. Compared to short-term performance, long-term business operations can provide more information to investors in risk assessment, which, in turn, affects risk compensation and the cost of equity capital required. Accordingly, we posit the following hypotheses regarding the relationship among CSR performance, operating risk, and the cost of equity capital:

Hypothesis 1. *There is a significant negative correlation between CSR performance and the cost of equity capital.*

Hypothesis 2. *There is a significant negative correlation between CSR performance and a company's operating risk.*

Hypothesis 3. *Operating risk is a mediating variable between CSR performance and the cost of equity capital, and the mediating effect differs between long- and short-term risks.*

2.2. Methodology

2.2.1. Data sources

The sample comprises A-share[1] listed companies in China from 2013 to 2018 with data from three databases: CSR data come from the Hexun Listed Company Social Responsibility Report Evaluation System (http://stockdata.stock.hexun.com/zrbg/); the analyst's earnings forecast data required for measuring the cost of equity capital come from the RESSET financial research database (http://www.resset.cn); listed company financial data and stock return data come from the CSMAR (China Stock Market Accounting Research) database (http://www.gtarsc.com/). After we delete samples with abnormal financial conditions and stock market transactions and those with missing data and outliers, we obtain a total of 7241 observations. The sample period is 2013–2018, with the sample number as follows: 1201 in 2012, 1110 in 2013, 1137 in 2014, 1228 in 2015, 1250 in 2016, and 1315 in 2017. To avoid the influence of extreme values, all continuous variables are winsorized at the 1 percent level.

2.2.2. Regression variables

2.2.2.1. Cost of equity capital (RE). The cost of equity capital can be divided into ex-post and ex-ante. Research on China's capital market shows that the ex-ante cost of equity capital does not accurately estimate the level of risk premium (Mao, 2012). Therefore, we adopt the ex-post cost of equity

[1] A-Share: RMB-denominated ordinary shares issued by companies in China.

capital. Further, considering the dependence of each model on the earnings forecasts assumption, the sensitivity to risk factors, and the condition of Chinese earnings forecasts over a short horizon, we use the price-earnings-growth (PEG) model (Easton, 2004) and the Ohlson–Juettner (OJ) model (Ohlson & Juettner-Nauroth, 2005) to measure the cost of equity capital. As abnormal earnings growth models, these two measurement methods not only are better for revealing the risk characteristics of China's capital market but also retain valid samples to the maximum extent.

PEG model:

$$RE_{peg} = \sqrt{\frac{eps_2 - eps_1}{p_0}}$$

RE_{peg} is the cost of equity capital; eps_1 and eps_2 are the forecasted earnings per share for the first and second years, respectively; and p_0 is the market price of the company's shares at the end of the current period.

OJ model:

$$RE_{oj} = A + \sqrt{A^2 + \frac{eps_1}{P_0}\left[\frac{eps_2 - eps_1}{eps_1} - (\gamma - 1)\right]}$$

$$A \equiv \frac{1}{2}\left[(\gamma - 1) + \frac{\delta \bullet eps_1}{P_0}\right]$$

$$\gamma = \lim_{t \to \infty} \frac{eps_{t+1}}{eps_t} = g_p + 1$$

RE_{oj} is the cost of equity capital measured using the OJ model; δ is the average dividend payment rate of the company in the prior three years; g_p is the long-term growth rate of earnings. Following previous research in China (Shen, 2007; Xiao, 2016), we set g_p at 5 percent. The OJ model assumes that stock prices are related to expected earnings per share for the next year, long- and short-term growth rates of earnings per share, and the cost of capital. The advantage of this model is that it only needs to predict future earnings and does not need to estimate the book value and return on equity.

Following Dhaliwal, Li, Tsang, and Yang (2011) and El Ghoul et al. (2011), we estimate the cost of equity capital using stock prices and analysts' earnings forecast data at the end of June calculated over sixty days, considering the disclosure time of CSR information and analyst delays. Moreover, we set a one-stage lag for the explanatory variables to match the assumption of a time lag, which helps reduce the endogenous interference with the regression results.

2.2.2.2 CSR performance (CSRP). Considering the coverage, availability, and transparency of the data, we proxy *CSRP* with Hexun CSR rating data. Hexun released a third-party evaluation system for the CSR reports of listed companies in 2010 along five dimensions: shareholders (30%), employees (15%), supplier and consumer rights (15%), environment (20%), and social responsibilities (20%), including thirteen secondary indicators and thirty-seven tertiary indicators for every dimension. The weights for the manufacturing, consumer, and service industries are adjusted based on these defaults.

2.2.2.3 Operating risk (OR). Because we are mainly examining operating risks, rather than stock market risks, including uncertainty in future earnings due to production, sales, investment, and other operation activities, we measure operating risk by volatility in accounting earnings, instead of volatility in market returns. Operating risk is measured by the volatility in the prior twelve-month return on assets (*ROA_TTM*), which helps reduce the impact of seasonal factors on earnings indicators. To analyze the difference between the short- and long-term effects of operating risk, short-term operating risk (*OR_s*) is measured using the standard deviation of eight quarters of *ROA_TTM*, covering the current year and the next year, whereas long-term operating risk (*OR_l*) is measured using the standard deviation of sixteen quarters of *ROA_TTM*, covering the prior two years, the current year, and the next year. Using two indicators helps increase the reliability of the empirical results, because data on long-term yield fluctuation can be affected by many external macrofactors, whereas data on short-term yield fluctuation could have measurement bias due to insufficient sample size.

2.2.2.4 Control variables (Controls). Control variables include company characteristics related to *CSRP* and *RE*, including the firm size (*Size*) measured as the natural logarithm of market value, the book-to-market ratio (*BM*) defined as the ratio of net assets to the market value of tradable shares, the return on net assets (*ROE*), firm leverage (*DTA*) defined as the ratio of total debt to common equity, market risk (*Beta*) estimated by Beta coefficients in the capital asset pricing model (CAPM), the turnover rate (*Turn*) estimated by the average daily turnover rate of tradable shares, and R&D (RD) estimated by the ratio of R&D expenditure to gross revenue (McWilliams & Siegel, 2001). The R&D expenditure data on 913 samples are missing. Following Zhang (2017), we assign to R&D (RD) a null value of 0.

Descriptive statistics for the variables are listed in Table 1. The mean values and variances of the cost of equity capital calculated based on PEG and OJ models are relatively close. The mean, minimum, median, and maximum values and the variance in *CSRP* are 0.3, −0.08, 0.25, 0.91, and 0.17, respectively. This shows that the overall level of *CSRP* in China is not high, and the distribution among listed companies is significantly uneven. Short- and long-term operating risk are highly volatile, indicating potential significant individual differences in operating risk. The mean value is lower for short-term operating risk than for long-term operating risk, indicating that companies face greater uncertainty in the long run.

This table presents descriptive statistics for the regression variables of the 7241 firm-year sample observations between 2013 and 2018, providing the mean, the first quartile, the median, the third quartile, the maximum and standard deviation of operating risk proxies, the CSR performance variable, and the firm-level control variables. Additionally, *CSRP* and

Table 1
Descriptive statistics for regression variables.

	Mean	Min	Q1	Median	Q3	Max	St. dev.
RE_peg	0.1	0.02	0.08	0.1	0.12	0.25	0.04
RE_oj	0.12	0.03	0.1	0.12	0.14	0.37	0.04
CSRP	0.3	−0.08	0.2	0.25	0.3	0.91	0.17
OR_l	2.5	0.08	1.03	1.72	3	49.89	2.71
OR_s	1.6	0.03	0.59	1.02	1.79	63.98	2.42
Size	0.16	0.14	0.15	0.16	0.16	0.21	0.01
BM	3.89	0.24	2.05	3.26	4.95	32.57	2.65
Beta	1.11	−2.06	0.94	1.11	1.28	4.09	0.32
DTA	0.4	0.01	0.24	0.39	0.55	0.98	0.2
ROE	0.1	−0.66	0.06	0.09	0.14	0.93	0.08
Turn	2.83	0.01	1.08	1.91	3.45	30.47	2.91
RD	4.12	0	0.77	3.24	5.06	72.75	5.23

Size are divided by 100 in the table to facilitate the comparison of regression results.

2.2.3. Model

This paper uses the causal-steps approach (Baron & Kenny, 1986) to test our three hypotheses: H1 is tested with model (1); H2 tested with model (2); and H3 tested with models (2) and (3). The causal steps are as follows.

The first step is to test the relation between *CSRP* and *RE*:

$$RE_{i(t+1)} = \beta_0 + \alpha_1 CSRP_{it} + \sum Controls + \sum Ind + \sum Year + \varepsilon_i \quad (1)$$

The second step is to test the relation between *CSRP* and the mediating variable *OR*:

$$OR_{it} = \beta_0 + \beta_1 CSRP_{it} + \sum Controls + \sum Ind + \sum Year + \varepsilon_i \quad (2)$$

The third step is to test the joint relation between *CSRP*, *OR*, and *RE*:

$$RE_{i(t+1)} = \beta_0 + \gamma_1 OR_{it} + \gamma_2 CSRP_{it} + \sum Controls + \sum Ind + \sum Year + \varepsilon_i \quad (3)$$

where $RE_{i(t+1)}$ is the cost of equity capital; RE_{peg} and RE_{oj}, respectively, are $RE_{i(t+1)}$ measured using PEG and OJ models. $CSRP_{it}$ is CSR performance. OR_{it} is operating risk, including long-term operating risk (*OR_l*) and short-term operating risk (*OR_s*). $\sum Controls$ Represents the control variables. To exclude the impacts of industry characteristics and macroeconomic changes on the cost of equity capital, *Ind* and *Year* are used to control for the fixed effects of the industry and year.

H1 is confirmed if the coefficient α_1 is significantly negative; H2 is confirmed if the coefficient β_1 is significantly negative. The test of H3 is as follows: if β_1, γ_1, and γ_2 are all significant, the mediating variable has a partial mediating effect; if β_1 and γ_1 are significant but γ_2 is not, the mediating variable has a full mediating effect.

3. Results

3.1. Bivariate correlations

The Pearson bivariate correlation matrix for the focal variables is in Table 2, showing that *CSRP* is positively correlated (at a significance level of 1%) with *RE* and negatively correlated (at a significance level of 1%) with operating risk (*OR*); however, the correlation between *OR* and *RE* is not significant. Additionally, the correlation coefficients of these variables are relatively low, and the value of the variance inflation factor (VIF) of the primary variables is lower than 5, suggesting the absence of multicollinearity.

3.2. Regression results

In our regression analysis, the primary variables (*OR*, *CSRP*, and *RE*) are standardized to facilitate comparison of the coefficients and analysis of the mediating effects. Moreover, we use clustered robust standard errors at the individual level to reduce the impact of heteroskedasticity.

Table 3 lists the regression results of the causal-steps approach. The results of model (1) indicate a significantly negative correlation ($p < 0.05$) between *CSRP* and *RE* (both *RE_peg and RE_oj*), confirming H1. The results of model (2) reveal a significantly negative correlation ($p < 0.01$) between *CSR*, *OR_l* and *OR_s*, and the coefficient of *OR_l* is larger than that of *OR_s*, confirming H2. The results of model (3) show that the coefficients of *CSRP*, *OR_l*, and *OR_s* are all significant ($p < 0.05$), but *OR_l* ($p < 0.01$) is more significant than *OR_s* ($p < 0.05$). Based on the mediating effect discrimination method in Section 2.2.3, the regression results of models (2) and (3) confirm H3, indicating that good CSR performance can reduce the cost of equity capital by reducing operating risks, and operating risk plays a partial mediating role.

Furthermore, the results of the control variables show that *Size* and *Turn* are significantly negatively correlated with *RE*, but *BM*, *Beta*, and *DTA* are significantly positively correlated with *RE*. This indicates that firms that are larger and have high stock liquidity, a lower book-to-market ratio, lower market risk, and lower leverage have a lower cost of equity capital. These results are consistent with those in previous studies (El Ghoul et al., 2011; Xu et al., 2015) and are in line with our expectations.

3.3. Mediating effect analysis

To explore the path of the impact of "CSR performance–operating risk–cost of equity capital," we

Table 2
Pearson correlation coefficients between regression variables.

	RE_peg	*RE_oj*	*CSRP*	*OR_l*
RE_oj	0.9739*			
CSRP	0.0883*	0.0301*		
OR_l	0.0047	0.0168	−0.0396*	
OR_s	−0.0191	−0.0116	−0.0545*	0.7027*

* p < 0.10; ** p < 0.05; *** p < 0.01.

Table 3
Regression results of the causal steps approach.

	Model (1)		Model (2)		Model (3)			
	RE_peg	*RE_oj*	*OR_l*	*OR_s*	*RE_peg*		*RE_oj*	
CSRP	−0.031**	−0.035**	−0.056***	−0.052***	−0.029**	−0.030**	−0.032**	−0.033**
	(0.014)	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.015)	(0.015)
OR_l					0.044***		0.052***	
					(0.014)		(0.015)	
OR_s						0.028**		0.030**
						(0.013)		(0.013)
Size	−4.056*	−5.008**	5.607**	2.407	−4.303**	−4.123*	−5.301**	−5.080**
	(2.102)	(2.146)	(2.302)	(2.075)	(2.097)	(2.103)	(2.136)	(2.144)
BM	0.048***	0.010	−0.013*	−0.029***	0.048***	0.049***	0.010	0.010
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
Beta	0.126***	0.104**	−0.060	−0.007	0.129***	0.127***	0.107**	0.104**
	(0.042)	(0.045)	(0.049)	(0.055)	(0.042)	(0.042)	(0.045)	(0.045)
DTA	0.859***	0.910***	−0.948***	−0.370***	0.900***	0.869***	0.959***	0.921***
	(0.082)	(0.085)	(0.095)	(0.090)	(0.083)	(0.082)	(0.086)	(0.085)
ROE	2.277***	0.925***	1.107***	0.909***	2.228***	2.252***	0.867***	0.898***
	(0.237)	(0.241)	(0.293)	(0.317)	(0.238)	(0.237)	(0.242)	(0.242)
Turn	−0.018***	−0.014***	0.068***	0.038***	−0.021***	−0.019***	−0.018***	−0.015***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
RD	−0.004	−0.002	0.014***	0.005	−0.005	−0.004	−0.003	−0.002
	(0.003)	(0.003)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
INTERCEPT	0.166	0.572*	−0.420	−0.280	0.184	0.173	0.594*	0.580*
	(0.324)	(0.332)	(0.349)	(0.315)	(0.323)	(0.324)	(0.331)	(0.332)
Year effect	YES	YES	YES	YES	YES	YES	YES	YES
Industry effect	YES	YES	YES	YES	YES	YES	YES	YES
Adj. R^2	0.230	0.163	0.149	0.070	0.231	0.230	0.166	0.164
F	129.529	83.666	43.137	20.122	120.193	120.150	78.119	77.892
N	7241	7241	7241	7241	7241	7241	7241	7241

This table reports results of the causal steps approach. Unreported industry controls are based on the industry classification of CSRC (2012). Robust t-statistics adjusted for clustering by firm are reported inside the parentheses.
* p < 0.10; ** p < 0.05; *** p < 0.01.

summarize these regression results and calculate the mediating effect ratio to analyze the intensity of the mediating effect. Table 4 lists the results, and Fig. 1 presents a diagram of the mediating effect. α_1 represents the coefficient of *CSRP* in model (1), indicating the effect of *CSRP* on *RE*. The indirect effects are calculated with $\beta_1\gamma_1/(\beta_1\gamma_1 + \gamma_2)$, in which β_1 represents the coefficient of *CSRP* in model (2) (indicating the effect of *CSRP* on *OR*), γ_1 denotes the coefficient of *OR* in model (3) (indicating the mediating effect), and γ_2 represents the coefficient of *CSRP* in model (3) (indicating the direct effect).

In Table 4, the *CSRP* coefficient (α_1) of model (1), *CSRP* coefficient (β_1) of model (2), and *OR* coefficient (γ_1) of model (3) are significantly positive, proving that the mediating effect of operating risk is significant. The *CSRP* coefficient (γ_2) in model (3) is significantly negative, indicating that operating risk plays a partially mediating role.

The mediating effect ratio of *OR_l* and *OR_s* is approximately 8 percent and 5 percent respectively, which shows that the mediating path of operating risk is significant. However, the mediating effect of long-term operating risk is stronger and more significant than that of short-term risk, for potential two reasons, of which the second is more important. First, the regression coefficient (β_1) of CSRP in the model (2) shows that CSR performance has a larger impact on long-term operating risk (*OR_l*). Second, the regression coefficient (γ_1) of operating risk in model (3) indicates that the positive correlation between long-term operating risk (*OR_l*) and the cost of equity capital is stronger. This means that, in China, long-term operating risk is more important in investors'

Table 4
Regression results summary in Table 3.

Variables proxies	*RE-CSRP*	*OR-CSR*	*RE-OR-CSRP*		Mediating effect ratio
	Model (1)	Model (2)	Model (3)	Model (3)	
	α_1	β_1	γ_1	γ_2	
OR_l-RE_peg	−0.031**	−0.056***	0.044***	−0.029**	7.83%
OR_s-RE_peg	−0.031**	−0.052***	0.028**	−0.030**	4.63%
OR_l-RE_oj	−0.035**	−0.056***	0.052***	−0.032**	8.34%
OR_s-RE_oj	−0.035**	−0.052***	0.030**	−0.033**	4.51%

* p < 0.10; ** p < 0.05; *** p < 0.01.

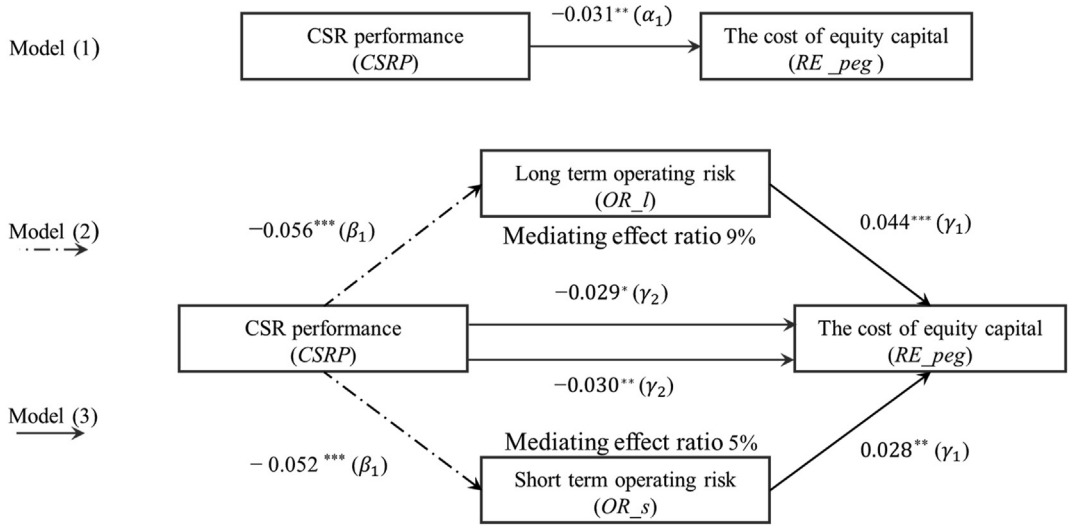


Fig. 1. Mediating effect diagram.

perceived risk, that is, investors make decisions about capital market pricing based on a firm's long-term performance more than on short-term performance.

This figure displays the mediating effect between CSRP, OR, and RE. The correlation coefficients displayed in the figure are regression results of the cost of equity capital measured using the PEG model.

3.4. Robustness tests

3.4.1. Instrumental variable (IV) estimation

The Chinese CSR system is not mature, which affects the availability and reliability of data. Although we add several important factors influencing the cost of equity capital to our regression models, the empirical tests related to CSR and the cost of equity capital often have endogeneity problems, such as having omitted variables and self-selection bias, which affect the robustness of the results. To mitigate this problem, we use an instrumental variable (IV) estimation.

Lin, Ma, Malatesta, and Xuan (2012) state that if endogeneity problems exist only at the firm level, industry/regional averages can be used as IVs for firm-level explanatory variables. Based on the secondary industrial classification of the China Securities Regulatory Commission (CSRC; 2012), we use the mean value of annual CSR scores of companies registered in the same location (*CSR_city*) and the mean value of annual CSR scores within the same industry (*CSR_ind*) as IVs. CSR activities in the same industry or same location of registration are affected by some common factors (e.g., competitive environment, degree of marketization, and stakeholder attention) and unaffected by the decisions of a single company. Therefore, these IVs satisfy the two conditions for IV selection: correlation and exogeneity.

Table S1 available online shows the results of the two-stage least squares (2SLS) regression of model (3). The regression of the first stage is in the first column, showing that *CSR_city* and *CSR_ind* are significantly positively correlated with *CSRP*. This indicates that the IVs have good explanatory power for the endogenous variable of *CSRP*. The regression of the second stage is in the last four columns. As shown in Table S1 available online, *RE* is negatively correlated ($p < 0.01$) with the predicted value of CSR performance (*P_CSRP*) and has a positive correlation ($p < 0.01$) with *OR_l* and *OR_s*. This shows that, after the problems of omitted variables and two-way causality are mitigated, the partially mediating effect of operating risk is still significant.

Table S1 available online also provide the results of the IV validity test. First, the *p*-value of the weak IV test is higher than 0.1, indicating the absence of a weak IV. Second, the *p*-value of the overidentification test is not significant. These results indicate that the selected IVs (*CSR_city* and *CSR_ind*) are valid. For details about Table S1, see the Supplementary Material, available online.

3.4.2. Alternative measures

We use industry-adjusted ROA volatility as a proxy for operating risk. Based on the secondary industrial classification of the CSRC (2012), we calculate this variable by subtracting the mean value of ROA in the same industry from ROA and then calculate its short- and long-term standard deviations. These standard deviations are used as an alternative variable for operating risk (*OR_Adjs* and *OR_Adjl*). We also use industry-adjusted CSR performance (*CSRP_Adj*) as a proxy for *CSRP*, with the same calculation method. In this section, we use only the PEG model (*RE_peg*) to calculate the cost of equity capital, controlling for the industry-fixed effect using the secondary industrial classification of the CSRC (2012). The results are summarized in Table S2 available online.

In Table S2 available online, the regression of model (1) is the first column, the regression of model (2) is in the second and third columns, and the regression of model (3) is in the last two columns. The results show that *CSRP_Adj* is negatively correlated with *RE_peg* at the significance level of 5 percent, confirming H1. The coefficients of *OR_Adjl* and *OR_Adjs* are consistent with Table 3, confirming H2 and H3. In general, the results of testing the alternative measures prove the robustness

of the previous results. For details about Table S2, see the Supplementary Material, available online.

4. Conclusions

The study reveals that CSR performance has a significantly negative correlation with the cost of equity capital; accordingly, actively engaging in social responsibility activities can help reduce the cost of equity capital. We also find that CSR performance is negatively related to operating risk, and operating risk is the mediating variable between CSR performance and the cost of equity capital. This suggests that good CSR performance can influence the risk expectation of investors and ultimately reduce the cost of equity capital by decreasing operating risk. In particular, the mediating effect is stronger and more significant for long-term operating risk than short-term operating risk.

CSR is a potential risk pricing factor in China's capital market, and operating risk is the internal mechanism of CSR that affects capital market pricing. Investors pay more attention to the company's long-term operating performance, so an active CSR strategy is more likely to affect investors' risk expectations and capital market pricing through long-term operating risks. The results confirm the positive effects of CSR on equity financing, which support the positive view of CSR in the literature (Bouslah et al., 2013; Chollet & Sandwidi, 2018; El Ghoul et al., 2011; Luo & Bhattacharya, 2009; Xu et al., 2015). We confirm not only the correlation between CSR and cost of equity capital but also the mediating effect of operating risk. This study extends the research on CSR's impacts on risk pricing, which not only provides support for companies that wish to implement long-term CSR strategies but also offers a reference for investors in evaluating corporate CSR performance.

The paper has the following limitations. First, it uses a sample of listed companies in China, however, the relation between CSR, operating risk, and the cost of equity capital may differ across regulatory systems and cultural environments. Therefore, a cross-cultural comparison is necessary, which offers an avenue for further research. Second, the data used to measure CSR performance in this paper come from a third-party public database. Although this source of data has been widely used in other research, its rating method might have limitations, so others should be used to verify our results. Third, these findings only illustrate the correlation between CSR performance, operating risk, and the cost of equity capital, however, interviews and other research work need to be conducted in order to look at the causality involved.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bir.2021.01.005.

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