

Equity Incentive and Operational Risk: An Analysis Based on Fixed Effects Model

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Abstract. Different people think that the impact of equity incentive system on business risk is different. In this paper, the impact of equity incentive on corporate risk is investigated. Based on descriptive statistical analysis, correlation coefficient matrix, univariate analysis and basic regression analysis, it is found that equity incentive is positively correlated with the company operation risk. Moreover, after a series of robustness tests, the relationship is still significant, including surrogate indicators, fixed effects and adding missing variables. Furthermore, we find that equity incentive has a greater impact on business risk when the proportion of investors holding shares is low. Nevertheless, it has no impact when the proportion of investors holding shares is high. These results support the view that equity incentive can improve the company operation risk, which shed light for the implementation of equity incentive in China's listed companies.

Keywords: equity incentive; corporate risk; firm value; management behavior.

1. Introduction

Equity incentive is that the company gives some shareholders' equity to employees who have achieved certain performance. When employees have shareholders' equity and become shareholders, they can participate in the company's decisions, share the company's dividends, and face operational risks with the enterprise. Equity incentive system is mainly built to improve the enthusiasm and efficiency of employees by tying the interests of employees and business interests together, i.e., improve enterprise performance.

Equity incentive is widely used in modern capital market, but there are many different theories on risk management. Part of the research argues that when the management incentive is insufficient or excessive, the investment efficiency will be low and the operation risk will increase [1]. Other scholars believe that the equity incentive of management will increase the systemic risk, thus increasing the total risk of the company [2]. Another theory holds that equity incentive has a positive effect on risk management. Some research argues that compensation management policy can determine the behavior of internal employees. For example, equity incentive can make decision-makers take more risks, so as to improve the performance of the company [3]. One of the theories is that equity incentive is a more expensive way for risk averse managers to take risks [4]. Although equity incentive was widely used by European and Western companies in the 1950s, equity incentive system began to rise in China only after the implementation of "management measures for equity incentive of listed companies" in 2006. With the rapid development of China's economy, more and more companies begin to use equity incentive system, which is a long-term incentive system used in the development of companies. Because of its short development time in China, people's analysis of him is too little. Hence, it is necessary to study the effect of equity incentive system on the corporate business risk. In China, the company structure is relatively centralized, but there is agency problem between the management and the shareholders. In foreign countries, equity incentive can be used to

solve the agency problem. Whereas if the company is not supervised and managed properly in China, it may cause the conflict of rights and interests between managers and shareholders, thus increasing the operational risk. Most of the companies in our country are growth companies, and the management's rights and interests are large, which leads to information asymmetry. With the increase of the size of the company, the supervision is more and more difficult. Some literature demonstrates that the appropriate equity incentive can attract talents and solve the conflict [5].

There are four main contributions of this essay. First, we find that the smaller the value of *Zscore* is, the higher the operation risk is. By finding out the variable including Shareholding ratio of senior management in year *t*, the natural logarithm of the book value of total assets in year *t*, firm financial leverage, the increased percentage of sales growth in year *t*, the shareholding ratio of the largest shareholder in year *t*, a dummy variable that equals 1 if a firm is a state-owned enterprise and 0 in otherwise, industry year that equity incentive affects operation risk, this essay constructs a model to analyze their impact on *Zscore*. Secondly, the ratio of the total compensation and the sum of equity value are used to measure the degree of equity incentive. According to the results, the higher the stock value is, the greater the equity incentive is. Through the research, we find that scale is the measure of enterprise scale, and the company is positively correlated with the business scale. Third, the greater the intensity of equity incentive, the smaller the operational risk. The natural logarithm of the book value of total assets in year *t*. The number of year the company has been listed, leverage and *CrossList* are positively correlated with operation risk. In the companies with low shareholding ratio, equity incentive has a greater impact on business risk, but in the companies with high shareholding ratio, it has no impact.

The remainder of this study is organized as follows. We develop our hypothesis in Section 2. Section 3 describes the research design, including sample selection, model specification, and variable measurement. The empirical results are discussed in Section 4. Section 5 provides robustness checks and Section 6 performs further analyses. Section 7 is conclusion.

2. HYPOTHESES DEVELOPMENT

Prior studies have found that corporate operating risk can be defined in many ways. According to the concept of wealth and value, it can be defined as the volatility of unexpected outcomes as it affects assets and liabilities [6]. There are three sources of risk that most companies would be faced with, including business risk, strategic risk, and financial risk [6]. In this paper, we will mainly focus on firm's operating risk (also identified as business risk), since business risk is the foundation of an enterprise and the essence of its operating activities. If a company controls its operating risk well through management's internal operating decisions, it will be exposed to plenty of competitive advantage in technology, distribution, or information, which leads to ultimately success [6].

Due to this fact, subsequent scholars have done researches on the determinants of corporate operating risk. For example, higher sensitivity of CEO wealth to stock volatility (vega) contributes to riskier policy choices, which is a representative of higher operating risk [7]. Additionally, the change in operating cycle and decline in R&D risk help the average firm reduces risk [8]. The report from Acharya et al. (2011) indicates that having strong creditor rights in a country leads firms to reduce risk, measured by the undertaking of diversifying acquisitions, lower cash-flow risk, and lower leverage [9].

Theoretically, there are two different views on the effect of equity incentive on corporate operating risk. One view is that the implementation of equity incentive will increase the corporate operating risk. The shareholders give high salary to executives in order to encourage them to work hard to improve the value of the enterprise. When the senior executives accomplish the enterprise's performance improvement goals, they may slow down, object to the project investment decisions with certain risks proposed by the enterprise owners [10]. When executives own a certain amount of stock in the company, they have the right to claim the residual value of the enterprise, i.e., the interests of business owners are directly linked to the self-interests of executives. Thus, executives are

encouraged to execute projects with high risks and high returns proposed by enterprise owners, and that will increase the company's operating risk [10]. Some researchers like Wang and Wu (2016) [11] and Zeng et al. (2014) [12] support this view. Scholars who support equity incentive believe the stock equity incentive boosts risk-taking incentives and alimentering incentives. According to principal-agent-theory, senior executives may ignore shareholder interest to satisfy their own interest, which is called agency problem. The stock equity incentive plan can be used to alleviate the agency problem by aligning executives' interests with those of the shareholders [13, 14]. Executives will pay more attention to the company's operating activities because they care about the stock price after getting stock equity. Thus, the operating risk of the company will decrease from this prospective. In addition, there are also studies suggest that stock options can provide an incentive to reduce total risk [15-17].

$$Zscore_{t+1} = \beta_0 + \beta_1 Stock_t + \sum_{q=2}^m \beta_q (qth\ Control\ Variable_t) + \varepsilon_t \quad (1)$$

Therefore, we propose two competing hypotheses for the effect of stock equity incentive on operating risk of the company.

H1a: The stock equity incentive plan to senior executives increases corporate risk.

H1b: The stock equity incentive plan to senior executives decreases corporate risk.

3. RESEARCH DESIGN

3.1 Construction of sample

Our sample initially comprised all firms listed on the Shanghai Stock Exchange and Shenzhen Stock Exchange and issued A shares from 2007 and 2018. We use the year 2007 as initial sample year because the new financial accounting standards were implemented in this year. We excluded the firms with missing values, financial firms and listed companies under special treatment as they account and report under rules, and have a different structure from other companies. We mainly selected our data from CSMAR. Finally, we get a usable sample of 15,556 observations.

3.2 Models

To test the relationship between the stock equity incentive and corporate operating risk, we employ the basic empirical model as follows.

Where β_i represents regression coefficients, ε is an error term; $Stock_t$ represent stock equity incentive. Besides, Control Variable contains $Size_t$, Age_t , Roa_t , Lev_t , Frs_t , $Growth_t$, $CrossList_t$. $Zscore_{t+1}$ is the proxy indicator of operating risk.

3.3 Variables

3.3.1. Dependent variable

Following Li and Han (2019) [8], we use the measure of $Zscore_t$ proposed by Atlman as an indicator of corporate operating risk. The calculation of $Zscore_t$ is given by:

$$\begin{aligned}
 Zscore_t = & \\
 & 1.2 \times \text{working capital} / \text{total assets} + 1.4 \\
 & \times \text{retained earnings} / \text{total assets} + 3.3 \\
 & \times \text{earnings before interest and tax (EBIT)} \\
 & / \text{total assets} + 0.6 \\
 & \times \text{total market value of stocks} \\
 & / \text{book value of liabilities} + 0.999 \\
 & \times \text{sales revenue} / \text{total assets}
 \end{aligned} \tag{2}$$

$Zscore_t$ is used to measure the likelihood that a business will fall into financial crisis, while a smaller value of $Zscore_t$ indicates higher operating risk.

3.3.2. Test variable

Following prior studies, we employ a formula to measure the degree of equity incentive for management, which is:

$$Stock_t = \frac{0.01 \times Price_t \times Share_t}{0.01 \times Price_t \times Share_t + Cashpay_t} \tag{3}$$

Where $Price_t$ indicates the stock price at the end of the year, and $Share_t$ is the number of share held by management at the end of the period, and $Cashpay_t$ shows the total fixed salary for management. This formula presents the proportion of incremental in the value of executive equity to the sum of total salary and equity value when share price increase 1%. The higher the value of $Stock_t$, the greater the equity incentive is.

3.3.3. Control variables

We control for several factors that relevant to corporate operating risk in prior studies. $Size_t$ is the measurement of the scale of the enterprise. Since the total assets of the companies are too large, the natural logarithm of total assets ($\ln(size_t)$) is used in this paper to replace the company size as the control variable. Li and Han (2019) [13] found that there is a negative relationship between company's size and operating risk. The variable Age_t is defined as the natural logarithm of one plus current year minus year of the listed, which is reported to have a positive relation with the risk [13]. We also add the variable $Roat_t$, which is the company's return on assets, calculated by net profit divided by total assets. Furthermore, we control for financial leverage (Lev_t), equal to the value of total liabilities divided by total assets. Frs_t is used to represent ownership concentration, which is defined as the shareholding proportion of the largest shareholder. Following Li and Han (2019) [13], we use $Growth_t$ to represent the growth of the company. The calculation equals to this year's main business income divided by last year's main business income then minus one. The variable $CrossList_t$ is a dummy variable used to measure whether the company is cross-listing, which is 1 if the firm is cross-listing and 0 otherwise. All continuous variables are winsorized at 1% at both tails.

4. EMPIRICAL ANALYSES

4.1 Descriptive statistics

Table 1 provides descriptive statistics for the variables used in our analysis. The mean of $Zscore_{t+1}$ is 1.183, which is an indicator of corporate operating risk. The mean of $stock_t$ is 0.177. The firms in our sample have an average $size_t$ of 22.130, an average of firm's age_t of 2.740, an average return on assets of 0.037, and an average $leverage_t$ of 0.497. The mean of shareholding proportion of the largest

shareholder, Frs_t , is 0.362. The average value of $Growth_t$ and $CrossList_t$ are 0.221 and 0.083 respectively.

Table 1. Descriptive statistics on corporate operating risk, stock and control variables for the sample in 2007-2018.

variable	N	mean	sd	min	p50	max
$Zscore_{t+1}$	15,556	1.183	0.777	-1.522	1.144	3.410
$Stock_t$	15,556	0.177	0.308	0.000	0.002	0.952
$Size_t$	15,556	22.130	1.356	19.400	21.950	26.110
Age_t	15,556	2.740	0.366	1.609	2.773	3.401
Roa_t	15,556	0.037	0.053	-0.181	0.033	0.200
Lev_t	15,556	0.497	0.201	0.0650	0.504	0.955
Frs_t	15,556	0.362	0.154	0.088	0.345	0.758
$Growth_t$	15,556	0.221	0.603	-0.569	0.119	4.593
$CrossList_t$	15,556	0.083	0.276	0.000	0.000	1.000

We calculate correlation coefficients between variables. As $Zscore$ is a measurement of the possibility of an enterprise falling into crisis, the smaller the $Zscore$ is, the higher the operating risk is. The results suggest that $stock_t$ is positively correlated with $Zscore_{t+1}$, which means the greater the equity incentive intensity, the smaller the operational risk, and vice versa. Besides, the firm's $size_t$, age_t , $leverage_t$ and $CrossList_t$ are positively correlated with operational risk. On the other hand, other variables, e.g., Roa_t , Frs_t and $CrossList_t$ can reduce the operating risk.

Table 2. Correlation analysis on corporate operating risk, stock and control variables for the sample in 2007-2018

	$Zscore_{t+1}$	$Stock_t$	$Size_t$	Age_t	Roa_t	Lev_t	Frs_t	$Growth_t$	$CrossList_t$
$Zscore_{t+1}$	1	0.170***	-0.111***	-0.142***	0.531***	-0.360***	0.085***	0.154***	-0.054***
$Stock_t$	0.143***	1	-0.057***	-0.125***	0.182***	-0.192***	-0.223***	0.102***	-0.108***
$Size_t$	-0.042***	-0.172***	1	0.250***	-0.079***	0.426***	0.193***	0.018**	0.224***
Age_t	-0.127***	-0.276***	0.217***	1	-0.141***	0.191***	-0.173***	-0.089***	0.127***
Roa_t	0.474***	0.156***	-0.038***	-0.119***	1	-0.421***	0.098***	0.290***	-0.017**
Lev_t	-0.341***	-0.265***	0.406***	0.209***	-0.388***	1	0.037***	0.031***	0.083***
Frs_t	0.097***	-0.163***	0.227***	-0.164***	0.097***	0.034***	1	0.020**	0.044***
$Growth_t$	0.043***	0.035***	-0.005	-0.004	0.163***	0.060***	0.046***	1	-0.032***
$CrossList_t$	-0.050***	-0.148***	0.280***	0.112***	-0.016**	0.085***	0.043***	-0.024***	1

4.2 Univariate analysis

Table 3 reports the results of the univariate analysis, in which we group the operational risks according to the high or low level of equity incentives (measured by the median). G1(0) represents the group with low equity incentive, and G2(1) represents the group with high equity incentive. According to the results, the group with high equity incentive, the mean value of operating risk was 1.3, while in the group with low equity incentive, the mean value of operating risk was 1.068. This further verifies the correlation coefficient analysis, that is operating risk is low when equity incentive is high.

TABLE 3. Univariate analysis on corporate operating risk, stock and control variables for the sample in 2007-2018.

Variables	G1(0)	Mean1	G2(1)	Mean2	MeanDiff	t-value
$Zscore_t$	7,840	1.068	7,716	1.300	-0.232	18.806***

4.3 Multivariate results

Table 4 reports the multivariate results. In column (1), with the fixed industry and year, the impact of corporate equity incentive on operating risk of the firm is explored without the addition of control variables. One sees that the coefficient of $Stock_t$ is 0.294 and the t value is 7.30, which is significantly

positive at the level of 1%. This indicates that equity incentive will reduce operating risk. Furthermore, column (2) introduces control variables. It is found that the coefficient of equity incentive to operational risk is still significantly positive when the control variables are added. This validates hypothesis H1a.

Table 4. Multivariate results on corporate operating risk, stock and control variables for the sample in 2007-2018. column (2) introduces control variables while column (1) is not.

	(1)	(2)
	F_Zscore	F_Zscore
<i>Stock_t</i>	0.294*** (7.30)	0.068** (1.98)
<i>Size_t</i>		0.077*** (6.31)
<i>Age_t</i>		0.004 (0.11)
<i>Roa_t</i>		5.369*** (22.60)
<i>Lev_t</i>		-0.922*** (-11.67)
<i>Frs_t</i>		0.386*** (5.38)
<i>Growth_t</i>		-0.002 (-0.15)
<i>CrossListt_t</i>		-0.104** (-2.11)
<i>_cons_t</i>	0.880*** (10.27)	-0.617** (-2.31)
<i>N_t</i>	15,556	15,556
<i>Industry_fixed_effect</i>	Yes	Yes
<i>Year_fixed_effect</i>	Yes	Yes
<i>r2_a</i>	0.118	0.361

4.4 Robustness test

Table 5 lists the results of our robustness test. The first and second columns are the results of replacing the stock incentive index of the company. In column (1), the ratio of the management shareholding to the total number of shares of the company is taken as the substitute index of equity incentive. Based on the results, the coefficient of equity incentive's influence on business risk is still significantly positive after replacing the index. Meanwhile, column (2) is also significantly positive. Column (3) is the result under individual effects of the firm. We find that when the individual effects of firms are taken into account, the results are still significantly positive. In column (4), in order to avoid the impact of missing variables on the results, we add a series of missing variables, where the result is still significantly positive.

Table 5. Robustness test on corporate operating risk, stock and control variables for the sample in 2007-2018.

	(1)	(2)	(3)	(4)
	$Zscore_{t+1}$	$Zscore_{t+1}$	$Zscore_{t+1}$	$Zscore_{t+1}$
$stock_t$	0.139** (2.19)	0.122*** (5.63)	0.158*** (4.54)	0.101*** (2.61)
$Size_t$	0.078*** (6.34)	0.075*** (6.18)	0.008 (0.96)	0.073*** (5.90)
Age_t	0.002 (0.06)	-0.011 (-0.37)	-0.352*** (-5.94)	0.001 (0.03)
$Roat_t$	5.385*** (22.78)	5.368*** (22.76)	2.234*** (24.43)	5.388*** (22.75)
Lev_t	-0.922*** (-11.65)	-0.931*** (-11.78)	-0.687*** (-18.01)	-0.925*** (-11.77)
Frs_t	0.377*** (5.35)	0.370*** (5.28)	0.199*** (3.37)	0.373*** (5.20)
$Growth_t$	-0.001 (-0.10)	-0.002 (-0.12)	0.069*** (11.30)	-0.001 (-0.07)
$CrossList_t$	-0.106** (-2.15)	-0.106** (-2.14)	0.029 (0.36)	-0.108** (-2.02)
SOE_t				0.047* (1.74)
$Big4_t$				0.002 (0.05)
$Gender_t$				-0.023 (-1.51)
ln_age_t				0.052 (1.42)
$Isduality_t$				-0.027 (-0.62)
$_cons_t$	-0.626** (-2.34)	-0.516** (-2.02)	1.923*** (8.16)	-0.737** (-2.47)
N	15,556	15,556	15,556	15,556
<i>Industry fixed effect</i>	YES	YES	NO	YES
<i>Firm fixed effect</i>	NO	NO	YES	NO
<i>Year fixed effect</i>	YES	YES	YES	YES
$r2_a$	0.361	0.361	0.154	0.361

4.5 Heterogeneity analysis

In order to explore whether there are differences in the impact of equity incentive on business risk among different types of companies, we conduct the following heterogeneous analysis. Column (1) indicates that the company is a state-owned enterprise, and column (4) indicates that the company is a non-state-owned enterprise. As shown in the Table, equity incentive has no effect on operating risk. Equity incentive only has an impact on non-state-owned enterprises in state-owned enterprises. In addition, in column (2), column (3), column (5) and column (6), we divide the company into high analysts, high institutional investors, low analysts, and low institutional investors. In companies with low shareholding ratio of analysts and investors, equity incentive has a greater impact on operating risk. Whereas, there is no effect where companies where analysts and investors hold a high proportion of shares.

Table 6. Heterogeneity analysis on corporate operating risk, stock and control variables for the sample in 2007-2018

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>SOE</i>	<i>High Analyst</i>	<i>High Ins</i>	<i>NON SOE</i>	<i>Low Analyst</i>	<i>Low Ins</i>
<i>stock1_t</i>	0.064 (0.56)	-0.038 (-0.97)	0.067 (1.15)	0.094** (2.22)	0.114** (2.38)	0.130*** (2.81)
<i>Size_t</i>	0.051*** (3.20)	0.002 (0.11)	0.039*** (2.61)	0.111*** (5.95)	0.103*** (5.62)	0.126*** (7.04)
<i>Age_t</i>	0.045 (0.85)	0.050 (1.38)	0.024 (0.60)	-0.019 (-0.47)	-0.019 (-0.37)	-0.021 (-0.47)
<i>Roat</i>	5.416*** (16.86)	6.965*** (23.02)	6.634*** (22.39)	5.262*** (15.56)	3.554*** (11.65)	3.881*** (11.82)
<i>Lev_t</i>	-0.914*** (-8.33)	-0.538*** (-6.09)	-0.655*** (-6.53)	-0.944*** (-8.55)	-1.069*** (-10.54)	-1.177*** (-11.09)
<i>Frst_t</i>	0.348*** (3.30)	0.260*** (2.95)	0.190** (2.00)	0.415*** (4.34)	0.547*** (5.62)	0.472*** (4.03)
<i>Growth_t</i>	0.026 (1.35)	-0.016 (-0.97)	-0.002 (-0.12)	-0.020 (-1.19)	0.011 (0.70)	-0.014 (-0.60)
<i>CrossList_t</i>	-0.055 (-0.97)	0.009 (0.16)	-0.049 (-0.92)	-0.225** (-2.49)	-0.184** (-2.35)	-0.135 (-1.45)
<i>_const</i>	-0.097 (-0.26)	0.731** (2.44)	0.167 (0.52)	-1.340*** (-3.43)	-1.068*** (-2.69)	-1.590*** (-4.04)
<i>N</i>	8,334	7,900	8,218	7,222	7,656	7,338
<i>Industry_fixed_effect</i>	YES	YES	YES	YES	YES	YES
<i>Year_fixed_effect</i>	YES	YES	YES	YES	YES	YES
<i>r2_a</i>	0.366	0.439	0.403	0.360	0.265	0.326

5. Conclusion

In summary, we investigate the impact of equity incentive on corporate risk. Based on descriptive statistical analysis, correlation coefficient matrix, univariate analysis and basic regression analysis, the equity incentive is positively correlated with the company operation risk. Moreover, after a series of robustness tests, the relationship is still significant, including surrogate indicators, fixed effects and adding missing variables. Furthermore, it is found that equity incentive has a greater impact on business risk when the proportion of investors holding shares is low, but it has no impact when the proportion of investors holding shares is high. Our research supports the view that equity incentive can improve the company operation risk.

According to the and analysis, the following suggestions are put forward. Primarily, for the company, not all their equity incentive can play a positive role. Specifically, it can actively use equity incentive for the growing company. The company should strictly supervise, so as not to increase the risk caused by the agency problem between shareholders and management. Secondly, for the Chinese market, the ownership of state-owned enterprises should not be too centralized. Since the control of large shareholders is too strong, which will lead to the weakening of equity incentive. In China's market, shareholders' equity should be decentralized, and the goal of large shareholders should be consistent with the management. Finally, the government ought to set up regulatory departments to supervise whether the company's equity is too concentrated, set the equity cap, limit the stock, and set the date, i.e., make the equity incentive more professional. These results offer a guideline for the implementation of equity incentive in China's listed companies.

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