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The effects of social responsibility on company value: a real options perspective of Taiwan companies

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ABSTRACT

Corporate social responsibility (CSR) is a subject that has garnered considerable attention in recent years. This study conducts the empirical study by using a real options perspective to examine whether a company's CSR commitment tends to increase its market value. According to Taiwan's CommonWealth Magazine, this study distinguishes CSR and non-CSR companies. The paper estimates and compares the real options values of CSR and non-CSR companies and shows that high percentage of the company value is attributed to real options. This study finds that a company's commitment to fulfilling its social responsibility increases its real options value and that the higher the number of CSR Awards won by a company, the higher its real options value. Compared with 10 years ago, investors now pay more attention to companies' CSR performance. In addition, the higher a company's size, systematic risk, fixed asset ratio, debt ratio, or skewness in stock returns, the higher a real options value is likely to be.

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1. Introduction

A concept of corporate social responsibility (CSR) has been widely discussed in international forums. In general, CSR refers to a company's ethical social behaviour and particularly the ethos that a company must account for not only its shareholders but also all stakeholders. Traditional finance theories posit that managers' ultimate goal is to maximize shareholder wealth. However, companies that always pursue ever-higher profits tend to create related social and environmental problems, such as climate change (Cadez & Guilding, 2017). Accordingly, international organizations have proposed CSR-related regulations mandating that companies resolve such issues, fulfil their CSR, and disclose relevant information (Bassen, Hölz, & Schlange, 2006). Stock market investors have begun to pay increasing attention to companies' social responsibility (SR) performance. Many companies participate in CSR activities even under the expectations of stakeholders and market pressure (Cadez, Czerny, & Letmathe, 2019).

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CSR involves the efforts and contributions made by companies to the needs of society and to the environment. CSR is a crucial factor facilitating sustainable business operations. When the company is committed to CSR, it may affect the company's profit and further affect the company's stock price. Companies that comply with corporate governance regulations and that are transparent in their financial reports are less likely to experience problems. Orlitzky, Schmidt, and Rynes (2003) and Nuryaman (2013) believed that companies that fulfil their CSR and ensure transparent information disclosure will enhance investors' trust, and thereby will increase their stock prices. On the other hand, CSR may increase the cost of the company and reduce the company's profit (Galant & Cadez, 2017). This result will in turn affect the company's stock price. According to literatures, scholars have studied the relationship between CSR and corporate performance and the relationship between CSR and stock price, and no consistent results have been obtained (Galant & Cadez, 2017). That is, inconsistent results include the negative relationship (Cardebat & Sirven, 2010), the positive relationship (Anginer, Fisher, & Statman, 2008; Cheung, Jiang, Mak, & Tan, 2013; Flammer, 2013; Wu & Shen, 2013), mixed relationship (Barnett & Salomon, 2012), and no correlation (Brammer & Millington, 2008; Shank, Manullang, & Hill, 2005). Nevertheless, more studies indicated a positive correlation than indicated other types (Orlitzky et al., 2003).

As CSR is increasingly emphasized by major countries and international organizations, Taiwan has also implemented various CSR-related practices. Since 2007, CommonWealth Magazine in Taiwan has started to publish special reports on benchmark firms and social citizens to advocate the importance of CSR. In addition, they annually select outstanding firms and confer them with the honours of Corporate Social Responsibility. These companies fulfil satisfactory CSR, have favourable social images, repay society, and are approved by consumers. They possess more competitive advantages than their rivals in the same industries (Huang, 2000). In addition to CSR awards conferred by media, an increasing number of companies have started to compile CSR reports.

The securities market is a crucial source of funding for companies. In addition to the aforementioned effects of CSR on corporate performance and of CSR on stock price in the securities market, some studies have conducted case studies to explore whether CSR-related announcements generated abnormal returns in the securities market (Deng, Kang, & Low, 2013; Flammer, 2013). The advantageous effects of CSR on company value are both tangible and intangible; the intangible effects include enhancing company reputation, improving companies' relationships with stakeholders, earning the trust of investors, increasing companies' resource usage efficiency, and boosting companies' innovation abilities (Fombrun, Gardberg, & Barnett, 2000; Porter & van der Linde, 1995). These favourable results may influence investors' assessments of the companies' future growth potential and thereby increase the companies' intangible value. Because the aforementioned characteristics meet the requirements of real options evaluations, real options evaluations can be used to assess the effect of CSR on company value. Husted (2005) analysed CSR within a real options framework in order to better capture the firm-level CSR decision-making process. He

indicated that CSR investments create the options value for the company to call upon stakeholders for resources it needs. This paper, hence, uses empirical data to investigate the effects of CSR on market value of a real options perspective.

Real options study allows companies to put a value on managerial flexibility and strategic dimensions of investment projects. The most strategic real options are embedded in contexts of ambiguity, intangibility, and subjectivity and thus are susceptible to the influences of individual cognition (Adner & Levinthal, 2004; Barnett, 2008; Krychowski & Quelin, 2010). Real options approach is very popular in the financial and managerial areas because of its viability for strategic management and risk analysis. It also works well with capital budgeting and resource allocation techniques, and it can test whether a particular venture is worth investing in (Hitch, Ravichandran, & Mishra, 2014; Trigeorgis, 1993).

Should the CSR affect a company's market value by the real options viewpoints? Enterprises investing in SR activities can gain the trust of investors, increase the efficiency of resource utilization, and improve goodwill (Fombrun et al., 2000; Porter & van der Linde, 1995). The impact may increase the intangible value of the firm and the investor's assessment of the company's future growth. According to a study by Husted (2005) and Cassimon, Engelen, and Liedekerke (2016), this feature is suitable for using real options perspective to test the impact of CSR on corporate value. Andres-Alonso, Azofra-Palenzuela, and Fuente-Herrero (2005, 2006) defined the real options value as the difference between its total market value and the value of its assets-in-place. They indicated that the market efficiency theory predicted that the total market value of a company will reflect available information regarding its real options portfolio. In this study, the effect of CSR on company market value based on a real options perspective is examined. Using the settings by Andres-Alonso et al. (2006), this paper attempts to test whether stock prices in Taiwan reflect investor's expectations regarding the value of CSR. The purposes of this paper are summarized as follows. (1) To estimate the real options values of CSR companies and compare them with non-CSR companies (the results will be shown in Table 1 and 2 of Section 4). (2) Using a panel data regression model to analyse the effect of CSR on company value of real options (the results will be shown in Table 3 of Section 4). (3) To examine whether investors have paid more attention to CSR companies in recent years (the results will be shown in Tables 4 and 5 of Section 4).

The contributions of this study to academic studies and actual practice are explained as follows. First, although the importance of CSR to companies is unquestionable, previous studies have focused on the effects of CSR on companies' financial performance levels and stock prices. This study delves into the effect of CSR on corporate value of real options. Second, few studies have explored CSR using the real options method (Cassimon et al., 2016; Hitch et al., 2014; Husted, 2005; Lee, 2017; Peters, Waples, & Golden, 2014). This study adopts the real options perspective to analyse investors' expectations of CSR companies. In addition, the related literatures have focused on conceptual or theoretical studies and do not present empirical models. This study performs an empirical study on the Taiwanese stock market. The results of this study may provide stock market investors with actionable insight into the effect of a company's CSR efforts on its market value.

The remainder of this paper is structured as follows. [Section 2](#) presents a literature review that summarizes relevant research on CSR a studies literatures of the real options component. [Section 3](#) discusses the methodology and data I use for the empirical analysis. [Section 4](#) examines the main results which emerge from the empirical analysis. [Section 5](#) concludes with some final observations.

2. Literature review

2.1. CSR and corporate performance

In general, CSR refers to corporate methods of operation that simultaneously satisfy responsibilities to stakeholders and are in line with social norms. In the context of CSR, whether a company is successful and whether a manager has done his or her due diligence is not measured solely by the profits generated but also by the overall social value created.

Numerous scholars have contended that CSR and stock price performance are positively correlated. When companies engage in SR activities favourably, their stock prices rise (Cheung et al., 2013; Flammer, 2013; Godfrey, 2005; Nuryaman, 2013; Orlitzky et al., 2003). The reasons why fulfilling CSR causes stock prices to rise are as follows: (a) fulfilling CSR enhances company reputation, preventing companies from suffering substantial damage due to negative news caused by negligence or intentional events. The occurrence of risks is thereby reduced, allowing the companies to be protected in a manner similar to that of insurance (Cheung et al., 2013; Godfrey, 2005; Kim, Li, & Li, 2014; Lin, Yang, & Liou, 2009; Orlitzky et al., 2003); (b) CSR creates welfare for employees and provides a favourable working environment; thus employees become more motivated to work for the company, thereby increasing company value (Edmans, 2011; Nuryaman, 2013); (c) fulfilling CSR can increase company revenue, company visibility, and customer loyalty (Nuryaman, 2013; Orlitzky et al., 2003; Servera-Francés & Piqueras-Tomás, 2019; Wu & Shen, 2013); and (d) when companies that fulfil their CSR enjoy subsequent profits and higher company value, investors become more willing to invest, which provides financial benefits to both the companies and their shareholders (Flammer, 2013; Orlitzky et al., 2003). Thus, a company that fulfils its CSR experiences positive effects such as increased company stock price. In addition, the number of institutional investors or their shareholding ratio will increase (Chen, Tang, & Hung, 2013; Graves & Waddock, 1994).

However, some studies have shown a negative correlation between CSR and stock prices. For example, Haveman and Christiansen (1981) found that companies that fail to meet relevant environmental regulations must invest additionally in areas such as workforce and equipment; without an increase in production or sales revenue, this investment results in a drop in overall performance. Cardebat and Sirven (2010) suggested that reduced company profits deprive companies of the funds required to fulfil their CSR. Lioui and Sharma (2012) asserted that when companies engage in CSR-related activities (i.e. community activities), they must bear the costs incurred, reducing profit. Goel and Thakor (2008) claimed that overconfident managers sometimes make value-destroying overinvestments, causing company value to decrease and exposing companies to excessive risk of liability. In addition to the aforementioned results (i.e. positive and negative correlations), some scholars argued that relevant

study results may be influenced by other factors, and may render the correlation indeterminate. Okamoto (2009) studied Japanese companies and found that because of external factors, CSR investments do not also equate to profit and growth, but rather, they demonstrate a nonlinear relationship between CSR and profit. Galant and Cadez (2017) indicate that the relationship of CSR and financial performance is equivocal. These outcomes include the positive, negative, no or U-shaped (mixed) relationships.

2.2. Real options analysis and CSR

A company can decide whether to invest CSR in a particular social or environmental aspect based on a definition of the risks and options available. Analysing real options can include assessing all tangible assets such as real estate, technological investments and so on (Hitch et al., 2014). Cassimon et al. (2016) indicated that the crucial insight of real options analysis is that the option concept can also be applied to CSR investments. Husted (2005) thought that CSR investments create the option, but not the obligation, for the company to call upon stakeholders for resources it needs. Hitch et al. (2014) also thought that CSR is a form of real options. However, few academic studies applied real options viewpoint to investigate CSR, especially for the related empirical study. This paper hence used empirical data to test the effects of CSR on a company's market value of real options.

Real options approach is very popular in the corporate world because of its viability for strategic management and risk analysis. Real options take into account the fields of undertaking activities and acquiring resources (Sanchez, 1993). The analysis gives the investor a chance to defer the decision on a particular investment until a certain environmental characteristic has revealed itself. McDonald and Siegel (1985) and Hsu and Lambrecht (2007) also emphasized that investing under uncertainty and irreversibility implied renouncing the options to invest in the future; therefore, investment consideration is a trade-off between postponing investment profits and renouncing such options. McDonald and Siegel (1986) and Dixit and Pindyck (1994) also proposed that the execution of an investment plan can be regarded as owning an option under the uncertainties of cost and price.

The market efficiency theory indicates that a company's market value will reflect available information regarding its real options portfolio. However, real options are abstract and not easy to observe by investors. That is, the principal proposition that companies' market valuations reflect the value of real options cannot be examined directly. In order to examine this proposition, Andres-Alonso et al. (2006) evaluated the relationship between the portion of the market value unaccounted by assets-in-place and variables disclosing information relative to the presence and characteristics of real options. Using the approach of Andres-Alonso et al. (2006) and Lee (2017), this article attempts to test whether real options value in Taiwan reflect investor's expectations regarding the value of CSR. That is, this article investigates which variables can be used by investors to approximate the market value of CSR held by a company.

CSR issues have been rapidly developing in the research field. However, studies applying real options theory to study CSR are very limited. Regarding related studies,

Husted (2005) argued that CSR is a type of real options. Using real options theory, Husted (2005) developed the notion of CSR as a real options and its implications for risk management. He suggested that CSR should be negatively related to a company's ex ante downside business risk. Peters et al. (2014) explored the conceptual relationship between CSR orientation and real options reasoning. Cassimon et al. (2016) also used a real options framework to study CSR investment. They extended the Husted (2005) model to explain CSR investment behaviour. They presented the timing of CSR investment and explained why some companies delay CSR investments. However, these literatures applied theoretical model (e.g. Black-Scholes model) to value CSR or study the effects of CSR.

3. Research methods and procedures

3.1. Study sample

Taiwan is an export-oriented emerging market. In addition to the Asian region, Taiwan's trade with Europe and the United States is also very frequent. The popularity of CSR around the globe indicates that Taiwanese companies must meet the demands and expectations of domestic and international customers to prosper in the international market. In 2010, to encourage Taiwanese companies to fulfil their SR, to promote economic, social, and ecological balance, and to facilitate sustainable development, the Taiwanese government formulated the Corporate Social Responsibility Best Practice Principles for TWSE/GTSM Listed Companies. On 19 September 2014, the Financial Supervisory Commission officially announced that the some companies are required to prepare and disclose their CSR reports.

Taiwan's CommonWealth Magazine has, since 2007, referred to international CSR-related indicators and assessment methods, such as the guidelines issued by the United Nations, the Organization for Economic Co-operation and Development (OECD), and the Dow Jones Sustainability Indices, and has selected the dimensions of corporate governance, company commitment, social involvement, and environmental protection to identify Taiwan's 'Top 50 Corporate Citizens.' A lot of studies (e.g. Fang, Huang, & Chen, 2011; Huang, Fang, & Chen, 2012; Huang, Wang, & Chang, 2013) used the data in this magazine to investigate related topics of CSR in Taiwan. Since 2012, the data were also used to issue CSR indices by CommonWealth Magazine and Yuanta Securities Investment Trust. In this study, the CSR companies (i.e. companies that have won the CommonWealth Magazine CSR Award) are selected to examine whether they have a high market value of real options.

In this study, the effect of CSR on company value of real options is examined. The study sample comprises companies listed in the Taiwan Stock Exchange (TWSE) between 2007 and 2016; data regarding these companies are obtained from the Taiwan Economic Journal (TEJ) database. The data frequency is seasonal. The companies are divided into CSR companies and non-CSR companies, where the CSR companies are companies identified by CommonWealth Magazine as being committed to fulfilling their CSR and demonstrating excellent CSR performance (such as the companies that win the CommonWealth CSR Award). That is, this paper uses the CSR award-winning conditions to distinguish between CSR companies and non-

CSR companies. The number of CSR companies totals 70. The remaining listed companies are basically non-CSR companies. However, the size of the company selected by CommonWealth Magazine must exceed the annual revenue of 286 million Euros, so the following criteria are further set for non-CSR companies: (1) companies that never win the CommonWealth Magazine CSR Award (the award is issued by CommonWealth Magazine every year; this study considers awards from 2007 to 2016); (2) companies that generate an annual revenue of 286 million Euros or more; and (3) companies that became listed companies before 2007. After deleting companies that do not meet the criteria, the number of non-CSR companies is 198. That is, for Taiwan-listed companies that meet the capital scale (286 million Euros) and listed for more than 10 years, this paper divides them into CSR companies and non-CSR companies through CSR awards. In addition to identifying CSR companies of CommonWealth Magazine, this study also tallies the number of times that the companies are selected as CSR companies during the 10-year period before analysing the effect of the number of awards on company value. Each company's market value of real options is measured using a panel data regression model. Variable definitions and model construction are explained in the following passages.

3.2. The estimation of real options value

For the company value of real options, this study follows the settings of Andres-Alonso et al. (2006). The proportion of real options (ROP) is defined as that proportion of a company i 's total market value not arising from its assets-in-place. The total market value of assets (MV) is calculated as the difference between the market value of equity (MVE) and the book value of equity (BVE) added to the book value of assets (BVA):

$$ROP_i = \frac{MV_i - V_i}{MV_i} = \frac{(MVE_i - BVE_i + BVA_i) - V_i}{MV_i} \quad (1)$$

The value of a firm i 's assets-in-place (V_i) is estimated by the present value of its current free cash flow (FCF) treated as perpetuity, and discounted at its cost of capital (K):

$$V_i = \frac{FCF_i}{K_i} \quad (2)$$

To approximate the free cash flow (FCF), this study assumes that replacement investments in current assets are equivalent to accounting depreciation. Thus, this study estimates FCF by subtracting adjusted tax payments from current earnings before interest and tax (EBIT):

$$FCF_i = EBIT_i - TAX_i \quad (3)$$

The discount rate appropriated to capitalize cash flow generated by assets-in-place (K) should summarize the average systematic risk of a company's existing assets (individual projects). As demonstrated in Chung and Kim (1997), the observed unlevered beta of a company is affected by the greater risk of its real options, and hence,

the corresponding capital cost could be too high for estimating its assets-in-place value. However, such betas are impossible to estimate and a proxy is required.

To approximate K , I estimate the firm-specific capital cost using a version of the CAPM, with the market portfolio (R_M) approximated using the Taiwan weight average index, and the risk-free rate (R_F) using the rate of time deposit:

$$K_i = R_F + (R_M - R_F)\beta_i \quad (4)$$

where β is the firm-specific beta of assets.

The analysis was implemented based on a sample of Taiwan listed companies. The related data was obtained from TEJ database. The remaining variables were estimated using accounting and market data at the end of 2016. This paper excluded companies for which data was not available, and those reporting negative free cash-flows, negative book value of equity, or $ROP < 0$.

3.3. The variable settings and basic model

This paper is going to test the significance of the CSR effects in explaining the proportion of total market value not due to assets-in-place. This paper proposes a panel data analysis, which has the merit of using information concerning cross-section and time-series analyses. The panel data approach has advantages compared to the cross-sectional approach often used in financial research. First, due to an increase in the number of data points, degrees of freedom are increased and multicollinearity problem is reduced thus the efficiency of econometric estimates is improved. In addition, Panel data can control for individual heterogeneity due to hidden factors, which, if neglected in time-series or cross-section estimations leads to biased results. Heterogeneity is captured by firm specific fixed effects or random effects components based on the characteristics of the data set.

From the literatures, there are many factors that influence the real option components in market value. The related variables are described below. First, as stated in previous section, CSR investments will affect real option value (Cassimon et al., 2016; Hitch et al., 2014; Husted, 2005). Besides, Adam and Goyal (2008) and Smit (2000) think that research and development expenditures are usually used to measure a firm's growth options. Company size represents a company's resources. As stated in Adam and Goyal (2008), larger firms are better prepared to obtain necessary funding to acquire and exercise the options. Andres-Alonso et al. (2006) indicate that capital stock can be used as a proxy for that proportion of a company's investment opportunities already realized. They also think that the increase in capital stock will increase the real options value. Firm leverage can be identified as a firm's ability to manage options in an efficient way. Increasing corporate leverage will decrease the market value accounted by options to invest (Andres-Alonso et al., 2006; Callen & Gelb, 1999). Andres-Alonso et al. (2006) and Bloom and Reenen (2001) find that higher market uncertainty will increase the value of real options. Finally, Smit (2000) thinks that the real options portfolio will shift the probability distribution of stock returns to the right and the proportion of the market value of a firm due to real options will

increase the skewness of its returns. The skewness of returns is obviously a variable affecting the real options component.

According to the above discussion, the real options value is affected by variables such as CSR, R&D expenses (expressed as RD), company size (AV), capital stock (CS), liabilities (LEV), risks (BETA), and skewness (SKEW). In addition, we can also expect that CSR, RD, AV, CS, BETA and SKEW variables will have a positive impact on the real options value based on past literatures, but LEV will have a negative impact. Using panel data method for Taiwan listed companies this study runs the following model to test the effects of CSR and other valuables on real options values:

$$\begin{aligned} \text{ROP}(K)_{it} = & \alpha_0 + \alpha_1 \text{CSR}_{it} + \alpha_2 \text{RD}_{it} + \alpha_3 \text{AV}_{it} + \alpha_4 \text{CS}_{it} \\ & + \alpha_5 \text{LEV}_{it} + \alpha_6 \text{BETA}_{it} + \alpha_7 \text{SKEW}_{it} + \varepsilon_{it} \end{aligned} \quad (5-1)$$

where i represents each company ($i = 1, \dots, N$), t represents the time period, α_j ($j = 0, 1, \dots, 7$) the coefficients to be estimated, and ε_i the error term. I refer to Andres-Alonso et al. (2006) and Anthony and Ramesh (1992) to construct the key factors in the model. The related variables are estimated as follows:

1. ROP measures the proportion of a company's market value due to real options. It is defined as the ratio of total market value minus value of assets-in-place to total market value. Total market value is calculated as market value of equity minus book value of equity plus book value of assets. Value of assets-in-place is estimated as the present value of current free cash-flow to the company treated as perpetuity. The discount rate selected to capitalize current cash-flows is the CAPM cost of capital (K).
2. CSR represents the company's commitment to social responsibility. CSR is set as the dummy variable and CSR companies and non-CSR companies are assigned values of 1 and 0, respectively. The criteria for distinguishing samples from CSR companies and non-CSR companies depend on whether the company wins the CommonWealth Magazine Award.
3. RD stands for R&D expenses. RD is defined as the ratio of research and development expenses to sales.
4. *AV stands for company size. AV is estimated on the basis of the log of the book value of assets.*
5. CS stands for capital stock. The fixed asset is used to express its meaning. CS is defined as the ratio of the book net value of property, plant, and equipment to total assets.
6. LEV stands for financial leverage, which is calculated as the ratio of book value of corporate debt with cost to total assets.
7. BETA stands for stock risk, which is measured by the CAPM coefficient of systematic risk of stock.
8. SKEW measures the skewness of stock returns.

To verify whether the number of CSR Awards won affected company's market value, the following equation was used:

$$\begin{aligned} \text{ROP}(K)_{it} = & \alpha_0 + \alpha_1 \text{NUM}_{it} + \alpha_2 \text{RD}_{it} + \alpha_3 \text{AV}_{it} + \alpha_4 \text{CS}_{it} \\ & + \alpha_5 \text{LEV}_{it} + \alpha_6 \text{BETA}_{it} + \alpha_7 \text{SKEW}_{it} + \varepsilon_{it} \end{aligned} \quad (5-2)$$

where NUM is the number of times that the CSR companies received the CSR Award; maximum and minimum NUM values were 10 and 1, respectively.

Companies identified by CommonWealth Magazine as CSR companies were selected and variables defined above were used to develop the panel data regression model. Subsequently, the companies' real options value was calculated. Then, the effects of CSR and control variables on company real options value as well as whether the number of times that companies received the CSR Award influenced real options value were examined. Because stock market investors have been paying increasing attention to CSR in recent years, whether the effect of CSR on company market price became more pronounced during this period was also studied. The empirical results are presented in Section 4.

4. The results and achievements

A panel data regression model is used to analyse the effect of CSR on company value of real options. The companies in the study sample are divided into CSR companies and non-CSR companies; the number of CSR companies and non-CSR companies are 70 and 198, respectively. Tables 1 and 2 show the descriptive statistics of and correlations between study variables for the CSR companies and the non-CSR companies, respectively. According to Table 1, CSR companies show an average return on capital (ROP) of 0.69, indicating that on average, 69% of a CSR company's value is attributed to real options value. In addition, the result shows that real option values of CSR companies stand at high percentage of the total market value. The effect of real options value on a company's market value is large.

Table 1. Descriptive statistics and correlation of the variables for CSR companies.

	Mean	STD	ROP	RD	AV	CS	LEV	BETA	SKEW	NUM	CSR
ROP	0.69	0.27	1.00								
RD	0.02	0.04	-0.20	1.00							
AV	25.65	1.56	0.26	-0.22	1.00						
CS	0.27	0.20	-0.12	-0.02	-0.18	1.00					
LEV	0.55	0.22	0.39	-0.49	0.51	-0.41	1.00				
BETA	0.65	0.54	0.12	0.15	0.16	-0.33	0.10	1.00			
SKEW	0.15	0.77	0.04	0.00	-0.04	0.00	0.00	-0.01	1.00		
NUM	4.79	3.16	0.05	0.08	0.31	-0.09	-0.02	0.46	-0.03	1.00	
CSR	1.00	0.00	-	-	-	-	-	-	-	-	-

Notes:

1. The standard deviation of CSR is 0. We hence cannot calculate the correlations between CSR and other variables.
2. The definitions of the variables in the table are as follows.

1. ROP measures the proportion of a company's market value due to real options.
2. RD is defined as the ratio of research and development expenses to sales.
3. AV means company size and is estimated by the book value of assets.
4. CS is fixed asset ratio and the ratio of the value of property, plant, and equipment to total assets.
5. LEV is the ratio of debt with cost to total assets.
6. BETA is the coefficient of systematic risk.
7. SKEW measures the skewness of stock returns.

Source: Own calculation based on Taiwan Economic Journal (TEJ) database and Taiwan's Common Wealth Magazine.

The mean values of the various variables for CSR companies are listed as follows: the CSR mean is 1 (because these companies are presented using a dummy variable value of 1); the NUM mean is 4.79 (signifying that during the 10-year period, the average number of being selected as CSR companies is 4.79); the RD mean is 0.02, which is considerably lower than that of OECD high-tech companies (i.e. 0.085); the systematic risk (BETA) mean is 0.65, which indicates that the CSR companies are exposed to a low systematic risk and that their systematic risk is lower than the theoretical systematic risk of the Taiwanese market (i.e. 1). Overall, the CSR companies show characteristics such as stable growth and low risks. Concerning the correlations between the study variables, real options ratio (i.e. ROP) is negatively correlated with RD ratio and fixed asset ratio (CS) and positively correlated with other variables. The correlation coefficient between ROP and NUM is 0.05, suggesting that the higher the number of CSR Awards won by a company, the higher its real options value is; however, the correlation is not prominent. Correlation coefficients are higher between AV and LEV (0.51), RD and LEV (−0.49), and NUM and BETA (0.46).

Table 2 shows the descriptive statistics of and correlations between the variables for non-CSR companies. For these companies, the ROP mean is 0.63, indicating that on average, 63% of the company value is attributed to real options. This percentage is lower than that of CSR companies. But the result shows that effect of real options value on a company's market value is still large. A mean difference *t* test is subsequently employed to compare the ROP values of CSR and non-CSR companies. The test result produces a *t*-value and *p*-value of 5.26 and 0.00, respectively, confirming that statistically, the ROP of CSR companies is significantly higher than that of non-CSR companies. This means that CSR companies have higher real options value and indicates that investors attribute greater future value to CSR companies.

The mean values of the various variables for non-CSR companies are as follows: the CSR mean is 1 (because these companies are presented using a dummy variable value of 1); the NUM mean is 0 (because these companies do not be selected as CSR companies during the sample period); the RD mean is 0.02, revealing that RD ratio in non-CSR companies is low and is similar to that of CSR companies; the BETA mean is 0.88, indicating that the systematic risk that the non-CSR companies are exposed to is lower than the theoretical systematic risk of the Taiwanese market but higher than that of the CSR companies. Regarding the correlation coefficients between the study variables, correlation coefficients are relatively high between AV and LEV (0.48) and low between other variables.

Table 2. Descriptive statistics and correlation of the variables for non-CSR companies.

	Mean	STD	ROP	RD	AV	CS	LEV	BETA	SKEW	NUM	CSR
ROP	0.63	0.50	1.00								
RD	0.02	0.03	−0.03	1.00							
AV	24.06	1.27	0.12	−0.12	1.00						
CS	0.26	0.17	−0.02	0.01	−0.16	1.00					
LEV	0.52	0.18	0.20	−0.26	0.48	−0.37	1.00				
BETA	0.88	0.42	0.06	0.15	0.17	0.03	−0.03	1.00			
SKEW	0.17	0.83	0.03	0.00	−0.01	0.02	−0.01	−0.07	1.00		
NUM	0.00	0.00	–	–	–	–	–	–	–	1.00	
CSR	0.00	0.00	–	–	–	–	–	–	–	–	1.00

Notes: The standard deviation of NUM and CSR are 0. We hence cannot calculate the correlation coefficients of NUM and CSR.

Source: Own calculation based on TEJ database.

The sample in this paper has the features of time series and cross-section. This paper uses the fixed effects model of the panel data analysis to test whether the value of real options reflects investor's expectations regarding CSR. The effect of CSR on real options value is shown in Table 3. Model 1 is used to measure the effect of CSR on real options value; CSR is set as the dummy variable and CSR companies and non-CSR companies are assigned values of 1 and 0, respectively. Model 2 is used to determine whether the number of CSR Awards won by a company influences its real options value; NUM denotes the number of CSR Awards won. The *F* value is 89, showing that the overall independent variables exhibit a substantial effect on real options value. The CSR coefficient and *t*-statistics are 0.036 and 2.97, respectively, indicating that CSR has a significant and positive effect on real options value and confirming that corporate commitment to fulfilling CSR improves investors' opinions of the committed companies and increases corporate real options value. Hence, fulfilling CSR will increase a company's market value because of high relation between market value and real options value. The correlations between real options value and BETA, AV, CS, LEV and skewness in stock returns (SKEW) are all significant and positive, indicating that increases in a company's systematic risk, company size, capital stock, debt ratio, and skewness in stock returns increase its real options value. This result is similar to the expected impact, except for LEV. That is, the positive impact of LEV is inconsistent with the views of relevant literatures (Andres-Alonso et al., 2006; Callen & Gelb, 1999). The result reflects that corporate debt is beneficial to the value of the real options. This may be because investors believe that the debt reflects the company's new or expanded investment opportunities. Of all the variables, only the coefficient of one variable, namely RD, is nonsignificant, possibly because most traditional industries do not invest in or spend money on research and development.

The effect of the number of being selected as CSR company on its market value of real options is further explored, and the empirical results are shown by Model 2 in Table 3. The NUM correlation coefficient is significant and positive, signifying that an increase in the number of being selected as CSR company increases its real options value, conforming to our expectation and indicating that companies invest in CSR-related activities and equipment and strive to win the public's approval in order

Table 3. Panel data regression—the fixed effect model.

	(1)	(2)
Constant	0.015 (0.173)	-0.026 (-0.300)
CSR	0.036*** (2.967)	-
NUM	-	0.004* (1.915)
RD	0.183 (1.142)	0.221 (1.391)
BETA	0.067*** (6.580)	0.059*** (6.049)
AV	0.009** (2.336)	0.011*** (2.898)
CS	0.159*** (5.729)	0.162*** (5.835)
LEV	0.570*** (18.125)	0.568*** (17.967)
SKEW	0.019*** (3.412)	0.019*** (3.381)
R-squared	0.063	0.063
Adj. R-squared	0.062	0.062
F-statistic	89.075***	88.293***

Notes: The symbols *** and * denote significance at the 1% and 10% levels, respectively. The *t*-statistics is reported in parentheses.

Source: Own calculation based on TEJ database and Taiwan's Common Wealth Magazine.

to increase company value. Similar to those results of Model 1, the correlations between ROP and BETA, AV, CS, LEV, and SKEW are all significant and positive. The F value is 88, meaning that the most independent variables in Model 2 exhibit a substantial effect on company value of real options.

In recent years, governmental efforts to introduce and promote CSR through the media have induced the public to give more attention to CSR. Thus, this study examines whether investors have thought more highly of CSR companies in recent years. The first and last three years of the study period (i.e. 2007–2016) are selected to analyse the effect of fulfilling CSR and increasing company value. The empirical results are shown in Table 4. According to the table, the CSR coefficient is positive but nonsignificant between 2007 and 2009, indicating no significant differences between the CSR and non-CSR companies in terms of the effect of fulfilling CSR on improving real options value. In other words, companies that invest in fulfilling their SR do not have higher real options value during those years. However, the CSR coefficient and t -value are 0.031 and 1.896 between 2014 and 2016, respectively, showing that CSR and real options value are positively correlated during those years. These empirical results signify that companies' commitment to fulfilling their CSR between 2014 and 2016 results in higher real options value and thereby higher company value. The results also explain why Taiwanese companies are paying increasing attention to CSR-related investments and performance. The BETA, LEV, and SKEW coefficients are all significant and positive during the two periods (i.e. 2007–2009 and 2014–2016), meaning that increases in a company's systematic risk, debt ratio, and skewness in stock returns increases that company's real options value. The correlation between ROP and AV and that between ROP and LEV are significant and positive for the two periods.

The F values are 8.287 and 77.333 for the two periods, respectively, indicating a significant effect (despite the substantial difference between the two values) of the overall independent variables on real options value during these periods. Comparison of the first three years with the last three years shows that public awareness of CSR is inadequate between 2007 and 2009; thus, CSR exhibits a minimal effect on company value of real options. However, between 2014 and 2016, such awareness has increased and is reflected in stock market investors' views of CSR companies. In other words, from 2014 to 2016, companies with fulfilling their SR have higher real options value.

Table 4. Effects of CSR for the first and last 3 years.

	2007–2009	2014–2016
Constant	0.007 (0.028)	-0.022 (-0.182)
CSR	0.039 (1.086)	0.031* (1.896)
RD	0.273 (0.595)	0.184 (0.885)
BETA	0.055* (1.661)	0.026** (2.037)
AV	0.019* (1.702)	0.005 (1.007)
CS	-0.037 (-0.473)	0.184*** (4.775)
LEV	0.321*** (3.612)	0.771*** (18.013)
SKEW	0.063*** (3.657)	-0.002 (-0.271)
R-squared	0.023	0.150
Adj. R-squared	0.020	0.148
F-statistic	8.287***	73.333***

Notes: The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The t -statistics is reported in parentheses.

Source: Own calculation based on TEJ database and Taiwan's Common Wealth Magazine.

Table 5 shows the effect of NUM on real options value; the NUM coefficients are positive but nonsignificant during the periods of 2007–2009 and 2014–2016). The result indicates that the number of being selected as CSR company in those two periods exerts a minimal effect in increasing its real options value. The F values are 73.132 and 8.214 for the two periods, respectively, showing a significant effect of the overall independent variables on real options value during those periods. From 2007 to 2009, the BETA, CS, and LEV coefficients are significant and positive, showing that increases in a company's systematic risk, fixed asset ratio, and debt ratio increases its real options value. From 2014 to 2016, the increase in a company's size, debt ratio, and skewness in stock returns can increase its real options value. Since 2014, investors have been paying more attention to CSR because of the government's promotion of CSR, and such awareness is reflected in companies' stock prices. However, the effect of the number of being selected as CSR company on its stock price is minimal for these two periods. This is mainly because investors are more concerned with whether companies are fulfilling their CSR and less concerned with the number of being selected as CSR company (as such information is not immediately obvious and the number of companies awarded is small). In addition, because most of the investors in Taiwan's stock market are individual investors, such information do not reflect on companies' market value.

5. Conclusions

Taiwan is an export-oriented emerging market and is close to trade with European and American markets. In the global trend of attaching importance to CSR, the Taiwan government and enterprises have separately formulated and adhered to CSR-related guidelines to facilitate the international trend. Unlike the stock market in US and Europe, Taiwan stock market has characteristics of small market, low efficient market, many odd-lot dealers, and high turnover rate. It is worthwhile to discuss the response of CSR in Taiwan stock market. By fulfilling CSR and establishing close relationships with major stakeholders, companies can create intangible assets such as enhanced reputation and favourable organizational culture, which increase the companies' asset usage efficiency and competitive advantage. However, engaging in CSR-related activities entails considerable costs and whether the advantages outweigh the

Table 5. The effects of NUM for the first and last 3 years.

	2007–2009	2014–2016
Constant	−0.041 (−0.336)	−0.022 (−0.090)
NUM	0.004 (1.548)	0.005 (0.821)
RD	0.206 (0.993)	0.308 (0.676)
BETA	0.021* (1.624)	0.044 (1.436)
AV	0.006 (1.211)	0.021* (1.880)
CS	0.187*** (4.846)	−0.037 (−0.478)
LEV	0.770*** (17.958)	0.320*** (3.581)
SKEW	−0.002 (−0.290)	0.063*** (3.665)
R-squared	0.149	0.023
Adj. R-squared	0.147	0.020
F-statistic	73.132***	8.214***

Notes: The symbols *** and * denote significance at the 1% and 10% levels, respectively. The t -statistics is reported in parentheses.

Source: Own calculation based on TEJ database and Taiwan's Common Wealth Magazine.

disadvantages remains unknown. Few studies have used real options approach to analyse the effect of CSR on companies, and most of them (e.g. Cassimon et al., 2016; Hitch et al., 2014; Husted, 2005; Lee, 2017; Peters et al., 2014) have focused on the theoretical description or model building aspects of the topic. In this study, empirical data are tested and a panel data regression model is employed to determine whether Taiwan's CSR companies enjoy higher real options value than non-CSR companies do.

The empirical results show that high percentage of the company value is attributed to real options. Compared with non-CSR companies, CSR companies have higher real options value. The companies with fulfilling their CSR elevate investors' opinions of the companies, the companies' real options value and hence companies' market value. The impact of CSR on company value has not yielded consistent results in the past, but more scholars think that there is a positive relationship (e.g. Anginer et al., 2008; Cheung et al., 2013; Flammer, 2013; Godfrey, 2005; Nuryaman, 2013; Orlitzky et al., 2003; Wu & Shen, 2013). The results of this paper also support this argument. The further results show that an increase in the number of being selected as CSR companies during the 10-year study period increases the company's real options value. The finding will encourage companies to invest in CSR-related activities and equipment and strive to win the public's approval in order to increase company value. In addition, according to the panel regression results, increases in a company's systematic risk, size, fixed asset ratio, debt ratio, and skewness in stock returns increase the company's real options value. Because of the public's increasing awareness of CSR, this study examines whether investors think more highly of CSR companies than they think of non-CSR companies. The effects of CSR on companies' value of real options during the first and last three years of the study period are also compared. The results show that companies that fulfil their CSR do not have higher company value between 2007 and 2009. However, CSR companies between 2014 and 2016 have higher real options value; this explains why Taiwanese companies are paying increasing attention to CSR-related investments and performance in recent years.

In terms of research restrictions, the Taiwan stock price has a daily limit of 10%. This limitation should not have a significant impact on the conclusions under the sample of the quarterly data used in this article, but future research can consider sample data without the price limit. This study uses award-winning companies to present companies committed to CSR activities, but this result can only show positive results. Future research can use positive and negative CSR news (see, for example, Krüger, 2015) to explore the impact of positive and negative CSR events on company value from a real option perspective.

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No potential conflict of interest was reported by the author.

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