

Idiosyncratic volatility, executive compensation and corporate governance: examination of the direct and moderate effects

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Abstract Entrenchment of private benefits by the CEO or dominant owners can lead corporations to avoid riskier but more private benefits resulting in greater idiosyncratic volatility and information flow trading. Using a unique database of 806 listed firms, we investigate the impact of CEO compensation and corporate governance on idiosyncratic volatility and information flow trading. We find strong and robust evidence that equity-based (fixed income) CEO compensation is negatively (positively) related to volatility and information trading. Incorporating an agent principal–principal perspective into our models of managerial discretion provides us with an accurate prediction of how the proportion of CEO compensation and the degree of entrenchment will influence risk-taking decisions as well as how equity-based compensation interacts with related-party transaction and ownership dispersion to influence stock volatility. Finally, we find that idiosyncratic volatility and information flow trading are also affected by CEO compensation and corporate governance, which act as instrumental variables, while subject to environmental variants and the jointly determined.

Keywords Idiosyncratic volatility · Panel data · CEO compensation · Corporate governance index · Agent principal–principal model

JEL Classification G11 · G12 · G18 · G32

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1 Introduction

In the Chinese equity market (including Taiwan and Hong Kong), the impact of shareholders identifying corporate risk-taking behavior remains largely unexplored, as does the question of what drives information trading and stock volatility (Bromiley 1991; John et al. 2008; Boubakri et al. 2013). In addition, even after reforms in the Chinese equity market, information regarding CEO compensation is not known for many firms due to a lack of records about compensation plans, increasing the potential to generate agency problems. For example, in the year 2008, it is known that 448 CEOs were not paid, indicating that CEO pay was not related to performance. However, a few CEOs received higher remuneration, as shown in over half of the listed companies, including Pricewaterhouse Coopers (PwC), the Ping An Insurance Group (PNGAY) and Gree Electric Appliances.¹

Jensen (1986) argues that managers' empire-building preferences will cause them to spend essentially all available funds on resource allocation (Firth et al. 2012), and that managers tend to be more risk-averse than shareholders (Sanders and Hambrick 2007). Here, we are interested in the question of whether managers learn from stock volatility. We present a panel data regression model of governance based on the premise that CEOs are the main initiator of governance change. CEO power affects the design of CEO compensation, the taking of non-profit objects to incur stock volatility, the extraction of private benefits to return the diverted income and the payment of a deadweight fee (Albuquerque and Miao 2009). Bebchuk et al. (2009) argued that CEOs exercise influence over the board of directors in order to pay them higher compensation with more private benefits. They are also inclined to seek to entrench personal benefits leading to risk aversion in persuading non-profit objects, whose extraction increases the volatility of CEO compensation (Durnev and Kim 2005; Klapper and Love 2004).

This study focuses on the theoretical mechanisms linking the design of CEO incentives to a firm's risk-taking decisions, building on the information trading link hypothesis and the agent principal–principal perspective. From the agency perspective, the best way to solve the problem is to align the interests of shareholders with CEO incentives which can be done by granting stock and stock options to the CEO to encourage lessening of opportunistic behaviors and decrease their extraction of private benefits (Baixauli-Soler and Sanchez-Marin 2014). CEO compensation is correlated with shareholders' interests (Sanders and Hambrick 2007), better corporate governance will lead to increased risk-taking behavior in pursuance of maximization of profit goals (John et al. 2008; Boubakri et al. 2013). In this study, we identify the moderating role of managerial discretion in this relationship.

Boubakri et al. (2013) examined earnings volatility after privatization in China. This current study focuses more on the relationship between CEO compensation and

¹ China's PwC announced that their compensation and salary growth rates have been higher than the corporation's profit growth rate since 2008. The directors and CEO of the Ping An Insurance (Group) Company of China received the highest compensation of all Chinese listed companies [over 66 million Renminbi (RMB) per year]. The directors and president of Gree Electric Appliances both received salaries of over 170 million RMB.

idiosyncratic risk in the Chinese corporate governance system which seems to be less than in the US, UK or Europe.² In neoclassical contracting models, investors are impacted by a severe information asymmetry problem which can lead to greater stock volatility or market failure of investment assets (Fama 1991; Su et al. 2008). Idiosyncratic volatility fully depends upon the use of private information for pricing formation in informed trading rather than public information (Roll 1988). Such information conveys meaningful signals about CEO entrenchment in relation to internal resources (Shleifer and Vishny 1997; Durnev et al. 2004; Roll 1988, 1989; Glostein and Milgrom 1985; French and Roll 1986). Decisions heightening risk-taking behavior lead to gaps between CEO decision-making and the governance power of the shareholders. CEOs evaluate stock options, depending on their idiosyncratic volatility (Devers et al. 2008). There is a link between greater idiosyncratic volatility and better CEO performance based on private information.

In the agency principal–principal conflict, CEO compensation reflects the CEO's bargaining power and ability to extract more private benefits from the board and major shareholders. Appointed CEOs usually control decisions made in the boardroom. In China, the ownership structure is dominated by state institutions (Ahn and Walker 2007; Young et al. 2008; Baixauli-Soler and Sanchez-Marin 2014). There is a lack of knowledge in relation to the influence of the majority of shareholders on the alignment of CEO compensation and private benefits with the effect of idiosyncratic volatility. Our findings suggest setting low levels of pay and higher proportions of contingent compensation in terms of equity-based income for CEOs. Preventing related-party transactions will reduce stock volatility.

Specifically, we construct and test corporate governance indexes (as in Bebchuk et al. 2009) for a sample of 806 listed companies in the Taiwanese stock market. Our results are economically important and contribute to the literature in several ways. First, to the best of our knowledge, no other study to date has investigated how corporate governance structures influence the flow of private information that drives idiosyncratic volatility and the pay-for-performance model (Conyon and He 2011). Second, many prior studies have suggested that good corporate governance serves as an effective mechanism to alleviate the opportunistic behaviors of CEOs and increases firm value (Lo et al. 2010; Chen et al. 2009; Bhagat and Bolton 2008). However, past studies may have ignored important determinants of agency principal–principal modeling and omitted variables. Our study aims to link relationships between CEO risk-taking behavior, information asymmetry and the idiosyncratic volatility in countries with emerging markets such as Taiwan.

The remainder of the paper is organized as follows. The background of the study and hypothesis development is detailed in Sect. 2. The control variables designed to capture such factors are introduced in Sect. 3. This section also includes a discussion of the overall regression design. Section 4 reports on basic data sources and describes the sample. The results are subjected to robustness checks including

² There is clear separation between ownership and management, as well as dominance of the board of directors by the CEO in US and UK listed firms. In European firms, CEOs are representatives of the majority shareholders and there is less differentiation between managers and owners in the ownership structure. Su et al. (2008) studied principal–principal conflict in the corporate governance of Chinese public corporations.

residual diagnostic checks and perturbation invariable construction in relation to the data sample, and for empirical specification of the regressions. Finally in Sect. 5 some conclusions are offered.

2 Literature review

2.1 Idiosyncratic volatility and the effect of CEO incentives on firm risk taking

Recent studies have shown that not all corporate governance systems worldwide necessarily converge with the US–UK model. There are, for example, idiosyncratic differences in institutional environments (Yoshikawa and Phan 2005; Young et al. 2008) and the principal–principal shareholders may be influenced by majority shareholders (Su et al. 2008), which could alter the dynamics of the governance process and, in turn, require remedies different from those for dealing with principle-agent conflicts (Young et al. 2008; Baixauli-Soler and Sanchez-Marin 2014).

Private information provides CEOs with meaningful feedback as stock prices change in response to their decisions (Durnev et al. 2003). Incomplete information generates excess volatility (Brennan and Xia 2001; Altı 2003), which may also lead to a reduction in the effectiveness of monitoring and increase the possibility of expropriation of a firm's rents either through compensation or related-party transactions (Baixauli-Soler and Sanchez-Marin 2014). John et al. (2008) put forth two arguments showing a positive association between investor protection and corporate risk-taking in poor governance countries. A company's dominant shareholders may receive large private benefits by virtue of their control (Morck et al. 2005; Stulz 2005). There is a negative association between investor protection and risk-taking because the action may indicate less fear of expropriation by CEOs and less need for dominant shareholders. All else being equal, when the market does not provide reliable information, managerial discretion is enhanced, and risk-taking behavior allows CEOs to have a stronger influence on firm decisions (Li and Tang 2010). To play it safe, insiders may seek to hold onto private benefits by avoiding value-enhancing but risky projects (John et al. 2008).

However, if assured of a certain level of compensation, managers should prefer fixed cash compensation over equity-based compensation (Mehran 1995). Equity-based compensation provides greater incentive for CEOs to improve performance compared to cash pay. Sanders and Hambrick (2007) proposed three dimensions to managerial risk: degree of outlay, variance of possible outcomes and the likelihood of loss to the investment decision. In order to reduce their own risk-taking behavior, CEOs seek to entrench private benefits by engaging in activities which induce idiosyncratic volatility.

Informational imperfections in capital markets can lead to a gap between CEO decision-making and the governance power of the shareholders. The risk-taking argument suggests that equity-based incentives influence CEO risk behavior (Devers et al. 2008). The proportion of incentives (fixed incentive relative to variable incentives) are inversely associated with subsequent firm risk taking

(Wright et al. 2007), if the CEO compensation is highly correlated with the firm's stock price, then CEOs have a direct incentive to care about the interest of shareholders (Kau et al. 2008). The type of shareholders and their relationship with the directors of the board have an influence on private information (Devers et al. 2008). Good compensation designs may help to align the interest of CEOs with those of shareholders leading to good firm performance (Bizjak et al. 1993; Datta et al. 2001; Chen and Chen 2012).

2.2 Private information and idiosyncratic volatility

In emerging markets such as Taiwan's and China's, where legal protection is weaker, minority shareholders may have to deal with expropriation from controlling shareholders who tend to dominate the CEO and board of directors. These individual may sometimes even directly intervene in corporate policy and investment decision making (Fan et al. 2007). Conflicting goals create agency costs as evidence through managerial perquisite consumption and entrenchment, like related-party transactions (Lo et al. 2010; Cheung et al. 2009; Khanna and Palepu 1997). For example, when the legal protection of minority shareholder rights in state-owned enterprises is weak, those in control are given to earnings management and tunneling practices through related-party transactions. Tunneling and propping are indicative of the intervention power of controlling shareholders who engage in connected transactions to safeguard their interests within a group of affiliated firms (Peng et al. 2011).

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Hartzell et al. (2004), and Wulf (2004) argued that CEOs engaged in negotiations to increase their private benefits (managerial discretion hypothesis). Due to special circumstances and the nature of Taiwan's law, this study uses the proportion of friendly directors on the board and the interlinking of the directorate to replace board classification. Other factors include independent directors, super majority, CEO duality, director education and CEO severance as stipulated by law (Brown and Caylor 2006). Gompers et al. (2003) offered evidence that the firms with the strongest takeover defense have lower share prices than firms with the weakest defenses. Agency theorists have argued that CEOs which are inclined to risk aversion are more entrenched, with heavier fixed income and private benefits

(Bebchuk et al. 2009). It is expected that the higher CG-indexes are traceable to the tendency of low transparency with higher stock volatility.

2.3 The moderating role of CEO compensation and related party transactions

Corporate governance mechanisms that help to determine the firm's value include the ownership structure, board composition and the incentive plans for CEO compensation. These features may give CEOs a stronger incentive to shift income inward so as to maximize performance-linked bonuses (Lo et al. 2010). This can be accomplished by related-party transactions, by private benefits and other methods (e.g., earnings management or manipulating transfer prices). The relationship can be understood on the grounds that the CEO may engage in private objectives and information manipulation to cater to the dominant shareholders. Either way, the CEO is inclined to hold onto private information and neglect the fairness of incentive-scheme plans. However, effective governance can help to guard against the expropriation of minority shareholder wealth (Chen et al. 2006). We argue that the decrease in the power of dominant shareholders acts to increase ownership dispersion, and that good corporate governance may help discipline the CEOs.

CEOs can have a preference to run a large business, instead of developing a profitable one, in order to consume the perks associated with firm size (Jensen 1986; Stulz 1990; Zwiebel 1996). Therefore, corporate governance matters for firms that incorporate private information during trading. This may be reflected in stock prices which could quickly lead to volatility (Chen et al. 2005; Gompers et al. 2003). CEO compensation can be affected by various political and social objectives (Yeh et al. 2009), or to satisfy dominant shareholders' benefits. Our expectation is consistent with Wright et al. (2007), who argued that lower risk-taking behavior may be related to the CEOs' personal wealth. CEOs may become risk averse because of bearing risks to substantial values of equity-based compensation. Diversification of personal risk through various tunneling mechanisms and by holding onto private benefits, as indicated by the interaction term, has a significant influence on the idiosyncratic volatility in the regression.

The implication is that CEOs have greater discretion; their impacts on firm decisions and performance are stronger (Finkelstein and Boyed 1998; Finkelstein and Hambrick 1990). They prefer listen to the market and the monitoring effect has greater influence through market governance (Kau et al. 2008). Managerial discretion might be some moderators of any relationship between CEO compensation and related-party transactions (Li and Tang 2010).

3 Conceptual framework and hypotheses

3.1 Testing empirical model

Prior research suggests that there are agency principal–principal perspectives between CEO risk-taking behavior and private information ((Baixauli-Soler and Sanchez-Marin 2014; Sanders and Hambrick 2007; John et al. 2008; Boubakri et al.

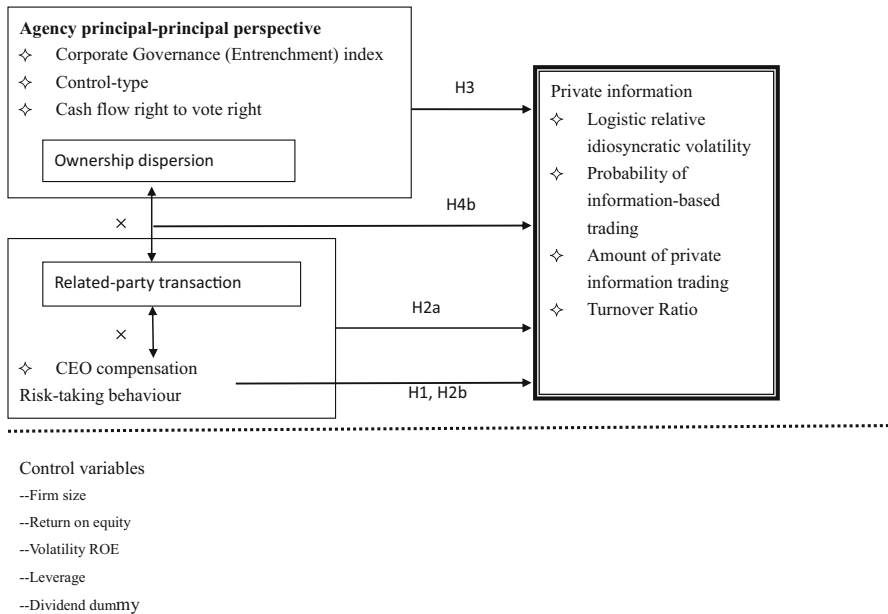


Fig. 1 Conceptual framework

2013). We use the CEO compensation context when analyzing the relation between corporate governance and two forms of risk-taking that differ in both incentive and risk aversion: equity-based compensation as a transparency and related-party transactions. We also investigate the impact of exogeneity on CEO risk-taking decisions.

Figure 1 shows an outline of the conceptual framework used in the analysis, clarifying the different dimensions of the effect of the corporate governance index and its influence on idiosyncratic volatility as well as proxy variables for private information, acting through the two channels. Several studies have indicated that CEOs want structured compensation structured so they take less taking-risk behavior (Mehran 1995; Wright et al. 2007). In order to reduce the firm's risk and encourage the CEO to engage in profit-oriented projects for shareholders, it is suggested pay be tied to performance through a greater percentage of equity-based compensation, and that shareholders should prefer more equity-based forms of compensation in order to reduce private benefits and idiosyncratic volatility.

We therefore expect there to be a negative relationship between idiosyncratic volatility and CEO equity-based compensation. The greater the idiosyncratic volatility, the less equity-based compensation available in Taiwan listed firms.

H1: CEO equity-based compensation is negatively related to idiosyncratic volatility.

To test the impact of CEO compensation on idiosyncratic volatility for Taiwanese listed firms, which are characterized as having a higher proportion of R&D expenditure in certain industries, we use as a measure for the CEO

compensation scheme, the weighted equity-based annual compensation to fixed salary. Equity-based annual compensation is the total market value calculated using stock options, restricted stock grants and the percentage of CEO ownership to market capitalization.

Baixauli-Soler and Sanchez-Marin (2014) argued that the related-party transactions have a reverse effect on CEO compensation, namely setting low levels of pay and high proportion of contingent compensation, can lead to a diminishing of stock performance. CEO risk-taking behavior is a key driver in the misappropriation of assets and misleading reporting in the weaker governance firms (Kohlbeck and Mayhew 2010). Therefore, we formulate two hypotheses about related-party transaction. There could be a positive relation between related-party transactions and joint CEO compensation with price volatility if investors perceive that controlling shareholders have an incentive to prop up a listed firm. This most commonly happens when that firm is facing financial distress or is in need of funding. The means by which they engage in such propping actions are capital injections, loan guarantees, related-party transactions and other types of profit transfers that move in the opposite direction to tunneling options (Friedman et al. 2003).

Higher contingent compensation always causes higher idiosyncratic volatility because of the private information shared in related-party transactions. Two-stage least squares regression is used to investigate the causality between CEO compensation and related-party transactions. The results show that CEO compensation is also negatively associated with idiosyncratic volatility.

H2a: A firm's party-related transactions and joint CEO compensation are positively related to idiosyncratic volatility.

H2b: A firm's party-related transactions are positively related to CEO compensation; CEO compensation is negatively related to idiosyncratic volatility.

Ownership dispersion has important consequences for the patterns of CEO compensation and CEO equity incentives (Core et al. 1999). When ownership is dispersed, powerful directors represent large shareholders who are agents of the state-owned equity (SOE) (Bai and Wang 1998; Su et al. 2008) or controlling shareholders who prefer to entrench their private benefits by expropriating from minority shareholders. CEOs are likely to advance their personal interests by expropriating from shareholders, they have ambiguous economic and social objectives in investing decisions and neglectful of the profit-oriented decision for dominants shareholders (Fama 1980; Johnson et al. 1996; Zajac and Westphal 1994). Core et al. (1999) and Shivdasni (1993) suggested that the holding of blocks of stakes by outside shareholders would mitigate potential CEO entrenchment and be negatively correlated with CEO compensation, but would be inefficient at monitoring those CEOs who receive more private benefits from their firm. Where ownership is highly dispersed, the controlling shareholders are typically passive in the governance of the firm, due to receiving private benefits and having little interest in strategy. Greater idiosyncratic volatility regardless of monitoring acts to constrain managerial power (Conyon and He 2011). Increases in ownership concentration are

expected to improve the governance effect while decreasing idiosyncratic volatility due to the incentives for large shareholders to monitor management.

H3a: Ownership dispersion in a firm is positively related to idiosyncratic volatility.

H3b: Corporate Governance Index increases are expected to be positively related to idiosyncratic volatility.

We follow the suggestion of Wright et al. (2007) using as a measurement the dollar value of the percentage of equity stakes, and the market capitalization of their stock option, with restricted stock grants and bonuses at the end of the year.

Some researchers have also used the managerial discretion perspectives to examine the relation between hubris and risk-taking decisions (Li and Tang 2010) although very little empirical evidence has been collected to link them to price information. CEOs are inclined to engage in related-party transactions and expropriate minority shareholders tend to ownership dispersion through which corporate governance affects firm value. These moderating effects have a significant impact on risk-taking decisions leading to the following hypotheses:

H4a: CEO compensation has a moderating effect on related-party transactions that affect idiosyncratic volatility.

H4b: CEO compensation has a moderating effect on ownership dispersion that affects idiosyncratic volatility.

It is verified that CEO compensation, PRT and CFR_VR significant shareholders have an influence on stock volatility, in this case using the variables $CEOPAY \times PRT$ and $CEPPAY \times CFR_VR$.

3.2 Regression models

Regression models are used to test that the relationship between idiosyncratic volatility, including proxy variables for private information and a firm's governance, and a set of control variables. The model is formulated as follows:

$$\begin{aligned} \psi(INF) = & \beta_0 + \beta_1 CEOPAY_{i,t-1} + \beta_2 ROE_{i,t-1} + \beta_3 VROE_{i,t-1} + \beta_4 LEV_{i,t-1} \\ & + \beta_5 MB_{i,t-1} + \beta_6 SIZE_{i,t-1} + \beta_7 DivDD_{i,t-1} + \beta_8 CFR_RF_{i,t-1} \\ & + \beta_9 CT_{i,t-1} + \beta_{10} CGI_{i,t-1} + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

where i is the indexed firm; t is a yearly time; CGI is a particular measure of the corporate governance index. The following control variables are included in our empirical design: profitability (ROE), profit volatility ($VROE$), leverage (LEV), market-to-book ratio (MB), market capitalization ($SIZE$), a dividend payer dummy ($DivDD$), control type (CT) and the degree of divergence ownership (CFR_VR). We measure the variables for each firm-year where possible.

The following equation is used to test H2:

$$\psi(INF) = \beta_0 + \beta_1 CEOPAY_{1,t-1} + \beta_2 ROE_{i,t-1} + \beta_3 VROE_{i,t-1} + \beta_4 LEV_{i,t-1} + \beta_5 MB_{i,t-1} + \beta_6 RPT_{i,t-1} + \beta_7 DivDD_{i,t-1} + \beta_8 CGI_{i,t-1} + \varepsilon_{i,t}, \quad (2)$$

The original samples are simply not related-party transactions as indicated in financial reports from the Taiwan Economic Journal (TEJ) database. A broad sample is selected and companies are checked and analyzed for related-party transactions and documentation. Then the amount of related-party sales and board characteristics are collected from the TEJ related-party transactions and corporate governance research database. Information including gross profit ratios of related party sales (RPT) and some governance variables are collected from the annual reports taken from the Market Observation Post System website.

3.3 Measure of idiosyncratic volatility

In testing, we need to develop measures of CEO compensation effected through the setting of principal–principal agent modeling for corporate governance mechanisms. We do this inclusive of the related-party sales transactions and compare them with the original results that have no reference to a PRT model. The dependent variables introduced in Durnev et al. (2004) and Ferreira and Laux (2007) are used. The equation is as follows:

Idiosyncratic volatility is obtained from the regression, for stock i :

$$E(R_{i,d}) = \alpha_0 + \beta_{i,d} R_{m,d} + e_{i,d}, \quad (3)$$

with $E(e_{i,d}) = \text{cov}(r_{m,d}, e_{i,d}) = 0$, where $E(R_{i,d})$ is the excess returns for stock i in month d ; and $R_{m,d}$ is the value-weighted excess market index returns in month d . For each observation, the cumulative abnormal returns are calculated using the companion portfolio approach. The abnormal returns for firm i in month d are computed as the difference between the stock returns for firm i in month d and the value-weighted average returns for Shanghai/ShangZen listed firms in the same size-decile, based on the market values. Then, $\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2}$, where $\sigma_{i,m} = \text{cov}(r_{i,d}, r_{m,d})$ and $\sigma_m^2 = \text{Var}(r_{m,d})$. From this projection, idiosyncratic variance is defined as

$$\sigma_{i,v}^2 = \sigma_i^2 - \frac{\sigma_{i,m}^2}{\sigma_m^2}, \quad (4)$$

where $\sigma_i^2 = \text{var}(r_{i,d})$.

Monthly return variances are estimated taking the sum of the square of daily returns in each month d , and the sum of the cross-products is used to estimate the return covariance. ψ Denote the idiosyncratic volatility measured relative to variations due to market-wide variations. One minus the average R^2 measures the idiosyncratic volatility in that industry, which can be expressed and j decomposed as follows:

$$R^2 = \frac{\sigma_{m,i}^2}{\sigma^2 + \sigma_{m,i}^2}, \quad \sigma_{e,i}^2 = \frac{\sum_{j \in i} SSR_{ij}}{\sum_{j \in i} T_j}, \quad \sigma_{m,j}^2 = \frac{\sum_{j \in i} SSM_{ij}}{\sum_{j \in i} T_j}, \quad (5)$$

Here, $SSR_{i,j}$ and $SSM_{i,j}$ indicate the unexplained and explained variations, respectively, of (5). The sums in (5) are scaled by the number of daily observations available for firm i .

Since $\sigma_{e,j}^2$ and $\sigma_{m,j}^2$ have a skewness of 6.104 and 1.033, respectively, and kurtoses of 45.02 and 37.10, respectively, a logarithmic transformation is applied. Both $\ln(\sigma_{e,j}^2)$ and $\ln(\sigma_{m,j}^2)$ are more symmetrical (skewness = 1.898) and normal (kurtosis = 3.851). However, this has the econometrically undesirable characteristic of being bounded within the unit interval. As recommended by Theil (1971), the bounded nature of R^2 is circumvented with the logistic transformation of $1 - R_i^2 \in [0, 1]$ to $\psi \in \Omega$,

$$\psi_{i,d} = \lambda n \left(\frac{1 - R_i^2}{R_i^2} \right) = \lambda n \left(\frac{\sigma_{e,i}^2}{\sigma_{m,i}^2} \right) = \lambda n \left(\sigma_{e,i}^2 \right) - \lambda n \left(\sigma_{m,i}^2 \right). \quad (6)$$

Intuitively, a higher value of $\psi_{i,d}$ might indicate that a high-intensity stream of firm-specific information is being capitalized upon for informed traders to predict a stock price. Here, $\sigma_{e,i}^2$, relative to market- and industry-wide variation, $\sigma_{m,i}^2$, is used in explaining the stock price movement of the firms. Now let $\ln(\sigma_{e,i}^2)$ denote logistic idiosyncratic volatility, $\ln(\sigma_{m,i}^2)$ be the absolute systematic risk and $\psi_{i,d}$ be the relative idiosyncratic volatility.

We also follow the private information trading hypothesis that tests for the relationship between governance and several dependent variables including of TURN, PIN and PRIVA (Ferreira and Laux 2007). TURN is measured monthly, to converge annually, and both PIN and PRIVA are measured annually, so in these cases t refers to an annual index.

3.4 Corporate governance variables

CEO compensation is composed of the end-year calculation of the market price multiplied by the stock held, stock options and restricted stock grants. The total value is divided by earning before taxes (Mehran 1995). A comprehensive corporate governance index (CGI, 1–10) is constructed and tested for a sample of 806 Taiwanese companies, essentially publicly traded Taiwanese firms. The variables are classified into six factors: shareholder rights (supermajority), board independence, board structure (board size, the proportion in the holding of friendly directors or directorate interlinking), board procedure (CEO duality), director education and severance pay. The six factors are assigned weights based on the references in Black et al. (2006), and Chen and Chen (2012). The fixed factors are combined into an overall index (CGI), as follows: add a firm's score for each non-missing factor divided by the number of non-missing total factors, on average. Each CGI has a value between 1 and 10. CGI (1–10) is defined as the sum of the six factors; better governed firms have lower scores.

The severity of agency conflicts is considered by using two firm-specific measures in the models. Both CT and ownership dispersion are used to place emphasis on the agent principal–principal problem. The control-type is defined as

the yearly control-type dummy, which is equal to one if the controlling shareholders are the family-type, and zero otherwise. CFR_VR is a proxy for the dispersion, which is defined as the discrepancy between cash flow rights and control rights based on the type of concentrated (dispersed) ownership structure. The control rights held by controlling holders of listed firms may exceed their cash flow rights, which lead to deviation between the two rights.

RPT measures the extent or related-party transactions as a ratio of the amount of related-party transactions between the controlling shareholders and the listed or parent company and its affiliates.

3.5 Other variables

Several control variables are included in Eq. (1). SIZE is controlled as a proxy variable to indicate the economy of scale of a large company with inferior cash holdings (Opler et al. 1999; Chen et al. 2012). MB is the market value to book value defined as the yearly log of the market-to-book ratio (equity and book value are TEJ items). Yearly return-on-equity (multiplied by four to annualize) is calculated by taking the most recent yearly earnings before extraordinary items divided by the book value of yearly (ROE). The others include sample variance of yearly ROE's over the last 3 years (VROE), long-term debt to total asset ratio (LEV) and the yearly dividend dummy, which equals one if the firms pay dividends, and zero otherwise (DivDD).

4 Results and suggestions

4.1 Descriptive statistics

The sample is drawn from manufacturing firms listed on the Taiwan Stock Exchange (TSEC) and over-the-counter center (OTC) for the period of 2001–2012. We begin our sample from 2002 because one of the main corporate governance (entrenchment) indexes is only available from 2002. Firms operating in the financial industry, where liquidity is hard to assess are excluded (Dittmar and Mahrt-Smith 2007), as well as firms in the highly regulated utilities industries and those with missing data. Information for firms with takeover bids, filings for bankruptcy and legal irregularities which affect major changes in top management, as well as unusual events that incur halts to trading is also deleted. The regulated utilities firms are arguably subject to a different bureaucratic system than unregulated firms and liquidity and governance might be driven by regulatory factors. Table 1 provides variable definitions, Panel A of Table 2 reports CEO compensation by industry. Industries are defined as in Taiwan's TSEC Market Observation Post System (MOPS). The industries with higher levels of CEO compensation in 2005 as well as idiosyncratic volatility are IT-related industry, Construction and Chemicals. By 2012, the leaders also are IT-related industries.

An examination of Panel A in Table 2 also shows that there is variation in our sample across industry classifications with higher sampling ratio. Panel B in Table 2

presents the distribution of observation in our sample according to the form of related-party transactions and by year. Balanced panel data need similar year-by-year financial data in our hypotheses. We get the complete information, 12,090 firm year observations and 806 unique firms³ for the panel data regression. Although the number of RPT varies considerably over time, the distribution suggests that the results reported in the subsequent sections of the paper are used by the cross-sectional regression to show the samples different from the requirement of CEO compensation. There is a total of 8,827 observations in the cross-sectional regression of RPT from 2002 to 2012.

Table 3 reports a summary of firm related statistical information, including CEO compensation, CG-index and idiosyncratic volatility (including other proxy variables for private information) by firm type in our sample. All variables are winsorized to reduce the effects of a few extreme values at the 5th and 95th percentiles.

The sample mean for idiosyncratic volatility is only 0.828. This low outcome could reflect risk aversion by decision-making CEOs (for supporting evidence see Albuquerque and Miao 2014), or dominant shareholders enjoying the private benefits of control at the expense of minority shareholders. These different explanations correspond to the expectation that entrenchment could cause greater idiosyncratic volatility and information flow by reducing risk-taking decisions or increased tunneling.

CEO compensation is skewed to the right as is evident from a comparison between the mean (1.452) and median (0.381). The mean (median) CGI of the principal component is 5.96(6). The mean related-party sales over total sales are 3.14 %.

From Table 3, we can see that the average PIN is 8.409, TURN is 7.557 % and PRIVA is 0.005. The table further shows that the skewness is not normally distributed over all variables. Here, the distribution of CGI is 0.208, unlike the Korean CGI which is 1.56 (Black et al. 2006). Turning to the control variables, Table 3 shows that the VROE is on average 135.513, but in the 75th percentile it is only 6.66. Finally, the average MB held by a sample firm is 14.99, the median value is 11.2 and for the 75th percentile it is 17.8. The value for the 95th percentile is 192.99, which means an extreme value effect on the returns. Therefore, we test the data ranging from the 25th to 75th percentile in the robustness tests. Table 3 also shows that among the sample firms, 62.3 % of the directors are subject to dominant shareholders. The mean of CEO compensation is greater than the median, which indicates that most of the companies have no equity-based incentives for CEOs or compensation design regardless of the equity-based measurement. The mean (median) CFR_VR is 79.36 % (90.93 %), showing a low ownership concentration in the sample firms.

Table 4 reports the Pearson's coefficients for the firm and governance variables. The correlations among the variables are generally low. The evidence suggests that

³ The nature of firm ownership is determined from annual reports. Almost all Taiwan listed firms have a controlling shareholder that controls 30 % or more of the votes or shares, who can elect half or more of the directors, and who can effectively control the listed company. Firms for which we cannot identify the type of ultimate controller are excluded from the sample.

Table 1 Definition of variables

Variables	Symbol	Definition
<i>Panel A: Idiosyncratic volatility variables (firm-level) and private information</i>		
Idiosyncratic volatility	$\sigma_{\varepsilon_{i,j}}^2$	Monthly idiosyncratic variance (multiplied by 12 to annualize) estimated from the market model
Logistic relative idiosyncratic volatility	$\Psi_{i,d}$	Monthly logistic transformed relative idiosyncratic volatility estimated from the market model
Probability of information-based trading	PIN	Annual probability of information-based trading from Easley et al. (2002)
Amount of private information trading	PRIVA	Annual amount of private information trading from Llorente et al. (2002) for each firm-year by $bi2$, estimated from the time-series regression: $rid = bai0 + bai1ri, day^{-1} + b2i2ri, day^{-1} + \varepsilon_{i,d}$, where rid is daily stock returns and Vid is the log daily turnover detrended by subtracting a 200 trading day moving average
Turnover ratio	TURN	Annual share volume divided by outstanding shares
<i>Panel B: PAY variables</i>		
Executive incentive measures	CEOPAY	CEO compensation is comprised of the end-year calculation of the market price multiplied by the stock holdings, stock options and restricted stock grants. The total value is then divided to fix the income. We use the CEO compensation divides earning before tax that proxy for CEOPAY
Related-party transactions	RPT	Ratio of the amount of related-party transactions between the listed company and the parent company (or its affiliates) to total sales
<i>Panel C: Corporate governance variables</i>		
Corporate governance index	CGI	Annual control-type dummy, which equals one if the controlling shareholders are of the family-type, and zero otherwise
Control-type	CT	The discrepancy between cash flow right and control right based on types of the concentrated (dispersed) ownership structure
Ownership dispersion	CFR_VR	
<i>Panel D: Control variables</i>		
Firm size	SIZE	Logarithm of total assets
Market-to-book ratio	MB	Annual log of the market-to-book equity ratio (end-of-year market value of equity obtained from the TEJ, and book value of equity is a yearly TEJ item)
Return-on-equity	ROE	Annual return-on-equity (multiplied by four to annualize) obtained from the most recent annual earnings before extraordinary items divided by the yearly book value

Table 1 continued

Variables	Symbol	Definition
Volatility of return-on-equity	VROE	Sample variance of yearly ROE over the last 3 years
Leverage	LEV	Annual leverage is defined as the ratio of long-term debt to total assets
Dividend dummy	DivDD	Annual dividend dummy, which equals one if the firms pay dividends, and zero otherwise

Table 2 Sample formation

Industry	Firms	Sampling ratio (%)	CEO compensation (2005)	Idiosyncratic volatility (2005)	CEO compensation (2012)	Idiosyncratic volatility (2012)
<i>Panel A: Sample distribution by industry</i>						
Cement	8	80	0.365	0.600	0.347	0.778
Food	24	92	0.106	0.595	0.169	0.652
Plastics	22	71	0.081	0.633	0.234	0.940
Textiles	45	98	0.221	0.630	0.171	0.796
Electrical machinery	40	53	0.974	0.477	0.751	0.688
Electrical cables and equipment	18	86	0.918	0.788	0.688	0.925
Chemical	38	97	1.261	0.300	0.589	0.815
Glass	5	100	0.220	0.590	0.418	1.019
Paper	7	100	0.044	0.672	0.118	0.716
Iron and steel	32	76	0.763	0.847	0.219	0.602
Rubber	10	83	0.132	0.827	0.111	0.894
Automobiles	3	100	0.119	0.838	0.281	1.004
IT-related	390	60	6.591	4.071	8.475	2.021
Construction	55	80	1.415	1.072	0.760	1.036
Transportation	22	92	0.126	0.992	0.072	0.817
Tourism	11	44	0.083	0.792	0.160	0.943
Consumer goods	14	50	1.070	0.604	0.622	0.868
Others	62	92	1.042	0.455	0.595	0.844
Sample retrieved	Panel data of CEO compensation			Cross section of related-party transactions		

Panel B: Related-party transaction data collection

2002	1,408	690
2003	1,362	740
2004	1,310	752
2005	1,182	752
2006	1,146	754
2007	950	752
2008	904	1,362
2009	871	753
2010	848	755
2011	811	758
2012	806	759
Final	806 (annual)	8,827 (total)

This table presents a description of the industry classification of 806 firms listed on both the TSEC and OTC, and 12,090 firm-year observations for 2001–2012 from the TEJ database used to calculate the explanatory variables in any year

IT-related industries include computers, IT services, communications, IC, IC design, IC seal to measure, Integrated Circuit Module thoroughfare businesses and consumer electronics. The sampling ratio is calculated from all data for the existing firms divided by all listed firms in this industry

Table 3 Summary of statistics

Variable	Mean	SD	5 %	25 %	50 %	75 %	95 %	Skewness	Kurtosis
IDVO	0.828	0.395	0.003	0.577	0.835	1.077	10.120	2.577	10.095
PIN	8.409	1.063	6.061	7.587	8.179	9.152	11.581	0.575	-0.462
TURN (%)	7.557	1.143	0.727	7.219	7.694	8.126	13.050	-0.172	2.415
PRIVA	0.005	0.02	-0.005	0.004	0.005	0.006	0.009	-0.464	0.464
CEOPAY	1.452	2.740	0.000	0.008	0.381	1.910	39.91	3.464	18.46
ROE (%)	0.051	0.435	-21.183	0.002	0.071	0.151	39.291	37.019	4,495.2
VROE	135.513	1,458.262	0.000	2.390	3.620	6.660	1,854.856	127.15	1,617.0
CT	0.623	0.485	0	0	1	1	1	-0.506	-1.744
CFR_VR (%)	79.364	25.869	0.000	68.800	90.925	98.821	100.000	-1.427	1.081
LEV (%)	0.440	0.397	0.000	0.294	0.433	0.558	38.815	59.014	5,440.8
MB	14.99	2.359	0.000	7.000	11.20	17.80	192.990	44.484	3,138.2
CG-index	5.96	1.66	1	5	6	7	10	0.208	0.458
SIZE	14.869	1.463	6.221	13.871	14.706	18.895	21.772	12.715	16.171
DivDD	0.528	1.137	0	0	1	1	1	6.318	86.589
RPT (%)	3.140	49.561	0.000	2.944	4.774	9.341	73.298	4.951	44.065

This table reports the mean, median, standard deviations, 95, 25, 75 and 5 % and number of observations of variables. All variables are as defined in Table 1. The sample period is from 2001 to 2012. Financial institutions and public utility companies are excluded from Eq. (1), and those firms that have sales transactions with their associated companies in Eq. (2)

Table 4 Pearson's correlation coefficient matrix

	(1)	(2)	(3)	(4)	(5)	(6)
$\psi(1)$	1.000	-0.015 (0.064)	0.016** (0.038)	-0.058*** (0.000)	-0.017** (0.033)	0.005 (0.543)
CEOPAY(2)	-0.011 (0.180)	1.000	0.119*** (0.000)	0.014* (0.076)	0.019** (0.013)	-0.051*** (0.000)
CGI(3)	0.005 (0.551)	0.172*** (0.000)	1.000	0.027*** (0.000)	0.107*** (0.000)	-0.206*** (0.000)
CT(4)	-0.041*** (0.000)	-0.054*** (0.000)	0.027*** (0.000)	1.000	0.171*** (0.000)	-0.008 (0.300)
CFR_VR(5)	-0.006 (0.443)	0.005 (0.509)	0.119*** (0.000)	0.204*** (0.000)	1.000	-0.011 (0.172)
ROE(6)	0.042*** (0.000)	-0.135*** (0.000)	-0.424*** (0.000)	-0.038*** (0.000)	-0.052*** (0.000)	1.000
VROE(7)	0.01 (0.123)	-0.034*** (0.000)	-0.020*** (0.000)	0.035*** (0.000)	0.015* (0.058)	-0.014* (0.074)
SIZE(8)	-0.103*** (0.000)	-0.082*** (0.000)	-0.122*** (0.000)	0.082*** (0.000)	0.027*** (0.001)	-0.052*** (0.000)
MB(9)	0.069*** (0.000)	0.060*** (0.000)	-0.227*** (0.000)	-0.060*** (0.000)	-0.030*** (0.000)	0.442*** (0.000)
LEV(10)	-0.008 (0.303)	-0.065*** (0.000)	0.219*** (0.000)	0.040*** (0.000)	0.048*** (0.000)	-0.097*** (0.000)
DivDD(11)	0.037*** (0.000)	-0.114*** (0.000)	-0.515*** (0.000)	-0.051*** (0.000)	-0.098*** (0.000)	0.736*** (0.000)
PRT(12)	0.396*** (0.000)	-0.015*** (0.006)	-0.011 (0.148)	-0.018 (0.396)	-0.008 (0.336)	0.001 (0.858)
	(7)	(8)	(9)	(10)	(11)	PRT(12)
$\psi(1)$	0.003 (0.707)	-0.100*** (0.000)	0.039*** (0.000)	-0.018** (0.020)	0.023*** (0.003)	0.152*** (0.000)

Table 4 continued

	(7)	(8)	(9)	(10)	(11)	PRT(12)
CEOPAY(2)	-0.002 (0.776)	-0.034*** (0.000)	0.063*** (0.000)	0.016** (0.043)	-0.060** (0.043)	-0.016** (0.046)
CGI(3)	0.001 (0.965)	-0.113*** (0.000)	-0.052*** (0.000)	0.165*** (0.000)	-0.358*** (0.000)	0.007 (0.364)
CT(4)	0.006 (0.423)	0.008 (0.334)	-0.025*** (0.002)	0.025*** (0.002)	-0.054*** (0.000)	0.002 (0.791)
CFR_VR(5)	0.001 (0.913)	0.008 (0.334)	-0.020*** (0.010)	-0.005 (0.503)	-0.049*** (0.000)	0.018** (0.026)
ROE(6)	0.001 (0.931)	-0.027*** (0.001)	-0.098*** (0.000)	-0.103*** (0.000)	0.208*** (0.000)	-0.005 (0.534)
VROE(7)	1.000	0.020*** (0.012)	0.001 (0.858)	-0.004 (0.598)	0.004 (0.649)	-0.001 (0.892)
SIZE(8)	0.060*** (0.000)	1.000	-0.022*** (0.006)	0.044*** (0.000)	0.022*** (0.005)	0.015 (0.055)
MB(9)	-0.048*** (0.000)	-0.017** (0.032)	1.000	-0.009 (0.237)	0.214*** (0.000)	0.000 (0.996)
LEV(10)	0.014 (0.085)	0.078*** (0.000)	-0.129*** (0.000)	1.000	-0.082*** (0.000)	0.001 (0.914)
DivDD(11)	-0.024*** (0.002)	0.025*** (0.000)	0.439*** (0.000)	-0.206*** (0.000)	1.000 (0.000)	-0.013 (0.000)
PRT(12)	0.007 (0.395)	-0.006 (0.441)	0.035 (0.000)	-0.004 (0.641)	0.013 (0.087)	1.000

The Pearson's coefficients appear above the diagonal and the Spearman rank coefficients are below the diagonal. This table reports the mean, median, standard deviation, 95, 25, 75 and 5 % and number of observations of variables. All variables are as defined in Table 1. This sample period is from 2001 to 2012. We exclude financial institutions, public utility companies in Eq. (1), and those firms that have sales transactions with their associated companies in the Eq. (2)

* Significant at the 10 % level; ** significant at the 5 % level; *** significant at the 1 % level

Table 5 Univariate tests

Variables	Percentage of sample (n = 1,349)	PIN	PRVA	TURN
CEOPAY	75th percentile of CEOPAY is below the mean 11.668	-0.001*** (-2.751)	-0.002*** (-2.531)	-0.002*** (-5.439)
CFR_VR	Percentage of cash flow rights to voting rights that if above 50 %	-0.003*** (-2.888)	-0.001 (-1.288)	-0.012*** (-2.549)
CGI	Corporate Governance Index is above 50 %	0.011*** (2.085)	0.003*** (2.306)	0.041*** (8.172)
CT	Dominant shareholders are of various types, family, affiliated or politically connected	0.036*** (5.325)	0.003*** (3.413)	0.033*** (5.164)
PRT	Party-related transactions are above 28.7 % (4,646/16,188)	0.106*** (2.935)	0.003*** (3.261)	0.379*** (4.981)
		0.240*** (4.984)	0.047*** (4.699)	0.627*** (9.106)
		0.468*** (3.829)	0.008* (1.844)	0.225*** (6.199)
		0.092*** (2.825)	0.002*** (3.574)	0.377*** (11.571)
		-0.028 (-0.395)	0.002** (2.133)	0.058*** (4.745)
		0.018*** (6.774)	0.004*** (3.844)	0.091** (2.056)
		0.033*** (3.773)		

All variables are as defined in Table 1. This sample period is from 2002 to 2012. CEOPAY is composed by taking the end-of-year calculation of the market price multiplied by the stock holdings, stock options and restricted stock grants, then dividing the total value to fixed income. CFR_VR is the proxy variable for ownership dispersion, the discrepancy between cash flow right and control right based on types of the concentrated (dispersion) ownership structure; CGI is the corporate governance index for internal corporate governance; CT is the type of dominant shareholders in all samples

Table 6 Idiosyncratic volatility, CEO PAY, corporate governance index

Variables	ψ		PIN		PRIVA		TURN	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	3.467*** (3.272)	3.272*** (3.732)	8.486*** (8.237)	8.429*** (4.647)	0.005*** (8.819)	0.005*** (7.685)	7.504*** (9.136)	7.512*** (6.825)
CEOPAY	-0.001*** (-2.034)	-0.001*** (-2.293)	-0.004*** (-2.093)	-0.001*** (-2.367)	-0.007* (-1.920)	-0.077*** (-2.177)	-0.006*** (-2.469)	-0.006*** (-2.488)
CFR_VR	-0.001 (-1.143)	-0.001 (-1.136)	-0.000 (-1.374)	-0.000 (-1.404)	-0.001** (-2.518)	-0.014** (-2.571)	0.002 (0.515)	0.002 (0.532)
CGI	0.036*** (2.587)	0.061*** (4.054)	0.007 (1.318)	0.015*** (2.788)	-0.004 (-0.047)	0.048 (0.517)	0.008 (1.533)	0.006 (0.942)
CT	-0.344*** (-7.219)	-0.330*** (-6.933)	-0.122*** (-6.962)	-0.117*** (-6.701)	-0.001*** (-5.101)	-0.001*** (-5.048)	-0.007 (-0.396)	-0.009 (-0.487)
ROE		0.061 (1.119)		0.045** (2.235)		0.001*** (4.235)		0.027 (1.266)
VROE		0.001 (0.736)		0.000 (1.095)		0.017* (1.838)		-0.000 (-0.557)
LEV		-0.147** (-2.542)		-0.068*** (-3.178)		-0.001*** (-2.838)		0.026 (1.150)
MB		0.045*** (4.545)		0.018*** (4.835)		0.027*** (4.458)		0.002 (0.618)
Dividd		0.035** (2.241)		0.006 (0.997)		-0.026*** (-2.732)		-0.009 (-1.498)
SIZE		-0.000 (-0.791)		-0.006 (-0.839)		-0.009 (-0.815)		0.007 (0.897)

Table 6 continued

Variables	ψ		PIN		PRIVA		TURN	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adj-R ²	0.319	0.534	0.280	0.513	0.169	0.418	0.058	0.036
p value	0.000	0.000	0.000	0.000	0.000	0.000	0.849	0.815

This table reports panel data with fixed effect estimation of the information flow and idiosyncratic volatility using the following equation:

$$\psi(INF) = \beta_0 + \beta_1 PAY_{i,t-1} + \beta_2 ROE_{i,t-1} + \beta_3 VROE_{i,t-1} + \beta_4 LEV_{i,t-1} + \beta_5 MB_{i,t-1} + \beta_6 SIZE_{i,t-1} + \beta_7 DivDD_{i,t-1} + \beta_8 CFR_RF_{i,t-1} + \beta_9 CT_{i,t-1} + \beta_{10} CGI_{i,t-1} + \varepsilon_{i,t}$$

All variables are as defined in Table 1. The sample period is from 2001 to 2012. We exclude financial institutions and public utility companies. The fixed effect is a set of dummy variables controlled for the year and firm-specific effect. Both model 3 and model 8 use alternative dependent variables. PIN is defined as in Easley et al. (2002), PRIVA is defined as in Llorente et al. (2002) and TURN is the turnover ratio. The samples include 806 a year, with total samples of 16,188 over the period in the panel regression

Significant at the 10 % level; ** significant at the 5 % level; *** significant at the 1 % level

each independent variable is potentially a candidate for inclusion in the regression model as a stand-alone element, rather than merely on the basis of being highly correlated with other variables. We can see that the CEO compensation and the idiosyncratic volatility variables show a tendency towards negative values where the results exhibit insignificant correlation coefficients. These relationships are statistically significant. As can be seen, all the correlation coefficients are moderate and do not violate the assumption of independence between the explanatory variables; thus multicollinearity does not appear to be a problem in our models. Generally, CEO compensation is more strongly correlated with the other variables, CT is significantly negatively related to ψ , whereas CFR_VR is significantly positively related to CT at 1 % confidence levels. Our findings are consistent with La Porta et al. (2002) who found that firms with concentrated ownership received lower market valuations, as well as with Su et al. (2008), who studied the agency principal–principal problem in China. Of course, the CG-index is negatively correlated with idiosyncratic volatility. These results may fill the void left by previous studies regarding the correlation between the governance index, entrenchment index and firm value.

4.2 Univariate analyses

Our main hypothesis argues that CEO compensation arising from a more effective governance structure would promote alignment more efficiently. According to Sanders and Hambrick (2007), Wright et al. (2007) and Devers et al. (2008), CEO risk-taking behavior needs to be compensation equity-based to reduce the conditions leading to the holding of private information and dominance of dominant shareholders. We examine our main hypothesis based on the different percentiles obtained in univariate testing. Results show that firms that have more equity-based compensation or pay more than the 75th percentile of CEO compensation have significantly lower idiosyncratic volatility and information flow trading than firms having less CEO compensation, based on the equity-based design (Table 5).

4.3 Multivariate analysis

Table 6 presents estimates of the basic model and the model with control variables from Eq. (1) in which logistic-transformed relative idiosyncratic volatility ψ and information flow (INF) are the dependent variables. This section describes the panel data regression with fixed effect results. We include an essential set of control variables to reduce omitted variable bias (Ferreira and Laux 2007), as well as taking into account the likelihood that our results are affected by adequate endogeneity. Despite these extensive control variables, CEO compensation is highly significant in each regression (coefficient in panel data firm-fixed-effects model = -0.001 to 0.077 , $t = -1.920$ to 2.488); the CGI also has a significantly positive impact on ψ (coefficient in our regression = 0.036 , $t = 2.587$). We progressively add additional control variables in the regressions (2, 4, 6, 8). Adding control variables has a greater effect on the coefficient of CGI, a moderate 10-point increase in CGI predicts a 0.61 increase in ψ .

Table 7 Inclusion of related-party transactions with corporate governance and idiosyncratic volatility

Variables	ψ	PIN	PRIVA	TURN
Constant	0.712*** (4.349)	7.669*** (11.938)	0.004*** (5.349)	7.431*** (9.579)
CEOPAY	0.008*** (3.964)	0.002*** (2.188)	0.0003** (2.470)	0.002* (1.744)
CGI	0.085*** (3.598)	0.034*** (3.423)	0.0007*** (4.025)	-0.002 (-0.204)
RPT	0.587*** (5.361)	2.268*** (6.017)	0.010*** (6.274)	0.168*** (3.891)
ROE	0.560*** (3.127)	0.348*** (4.633)	0.0008*** (6.210)	0.145* (1.646)
LEV	2.210*** (4.076)	0.449*** (5.222)	0.0004** (2.419)	0.138 (1.375)
MB	0.011 (0.787)	0.014** (2.174)	0.0003*** (2.799)	0.008 (1.129)
DivDD	-0.039*** (3.598)	-0.022*** (-3.088)	-0.0006*** (-4.768)	-0.013 (-1.586)
VROE	0.007 (0.413)	-0.002 (-0.0286)	0.0008 (0.594)	0.0004 (0.045)
Adj-R ²	0.386	0.225	0.065	0.003

This table reports the pooling OLS regression estimated for information flow and idiosyncratic volatility using the Eq. (2); all variables are as defined in Table 1. The sample period is from 2002 to 2012. We exclude non-related party transactions. Both model 3 and model 8 used alternative dependent variables. PIN is defined as in Easley et al. (2002), PRIVA is defined as in Llorente et al. (2002) and TURN is the turnover ratio. There are 8,827 observations in the sample

Significant at the 10 % level; ** significant at the 5 % level; *** significant at the 1 % level

We find that the CG-index is positively related to idiosyncratic volatility which supports H3b and higher entrenchment with higher information flow. Bebcuk et al. (2009) and Gompers et al. (2003) studied the correlation between governance and returns during a given period which is subject to several different possible explanations. This result is inconsistent with Ferreira and Laux's (2007) made using the Investor Responsibility Research Center (IRRC) database. The entrenchment index represents managerial discretion which is different from the governance index in a large set (Gompers et al. 2003; Ferreira and Laux 2007). It is also suggested that a higher entrenchment indicates less risk-taking behavior, greater idiosyncratic volatility and worse transparency. Corporate governance variables predict that the stock volatility changes from 3.353 (no control variables) to 4.523 (has control variables), compared with a sample mean of 3.370. This is an economically meaningful prediction to alleviate the agency principal-principal problem for a firm with CEO compensation and corporate governance variables equal to the sample means.

Table 6 presents the results showing the effect of equity-based CEO compensation on information flow and idiosyncratic volatility across many lines of

Table 8 Moderating effect on the relationship among idiosyncratic volatility, CEOPAY and corporate governance

Variables	ψ	PIN	PRIVA	TURN
Constant	7.019*** (10.506)	10.635*** (4.301)	0.009*** (7.236)	8.042*** (5.994)
CEOPAY	0.006 (0.642)	0.0008 (0.271)	0.0004 (0.734)	0.004 (1.157)
CGI	-0.009 (-0.277)	-0.0243* (-1.952)	-0.0005** (-2.346)	-0.016 (-1.203)
CFR_VR	0.004** (2.116)	0.001 (1.294)	-0.0001 (-0.991)	0.001* (1.715)
RPT	-1.264** (-2.436)	-0.440** (-2.290)	-0.0002 (-0.529)	-0.168 (-0.834)
CEOPAY \times CFR_VR	-0.0002** (-2.152)	-0.0006* (-1.727)	-0.0001* (-1.769)	-0.0006* (-1.722)
CEOPAY \times RPT	0.691** (2.481)	0.008** (2.076)	0.0001* (1.659)	0.008* (1.861)
LEV	0.691** (2.481)	0.184* (1.791)	0.0006*** (3.816)	0.163 (1.511)
SIZE	-0.251*** (-6.978)	-0.139*** (-10.452)	-0.003*** (-4.331)	-0.036*** (-2.579)
ROE	0.536*** (2.673)	0.241*** (3.244)	0.0005*** (3.908)	0.063 (0.815)
Adj-R ²	0.188	0.326	0.451	0.146

This table reports the pooling OLS regression estimation for the moderating effect and main effect among the idiosyncratic volatility (information flow trading), CEO compensation and corporate governance index

All variables are as defined in Table 1. The sample period is from 2001 to 2012. We exclude non-related party transactions. Both model 2 and model 4 use alternative dependent variables. PIN is as in Easley et al. (2002); PRIVA is as in Llorente et al. (2002) and TURN is the turnover ratio. There are 8,827 observations in the periods

Significant at the 10 % level; ** significant at the 5 % level; *** significant at the 1 % level

business. To the extent that there is a higher proportion of market capitalization of remuneration than fixed income, there is less volatility in the stock price. As for the firm-specific controls, we find that the leverage ratio (LEV) and market-to-book (MB) are significantly negatively and positively associated with ψ and information flow trading, suggesting that more internal funds and higher growth opportunity are substitutes for stock volatility and information flow trading. In addition, we find that the ROE, VROE and dividend dummy variables enter the regressions with significant coefficients. These findings suggest that firms with better profitability and higher dividend yield hoard more private benefits. Overall, those results are consistent with prior studies, proving that risk-taking behavior incurs more private information on stock volatility, and that profitability declines as the equity-based compensation becomes weaker as a governance mechanism. Our results are also

Table 9 Simultaneous or determinants of instrumental variables

Variables	Simultaneously variables				Instrumental variables			
	ψ	PIN	PRIVA	TURN	ψ	PIN	PRIVA	TURN
Constant	-8.846** (-2.028)	7.859*** (4.585)	0.0008 (0.75)	3.717** (2.332)				
CEOPAY	-0.382*** (-2.709)	0.010 (0.976)	-0.0008*** (-2.429)	-0.140*** (-2.717)	0.254*** (8.94)	0.628*** (6.403)	0.0003*** (4.031)	0.564*** (6.040)
CGI	2.797*** (2.903)	0.072 (0.999)	0.001*** (3.401)	0.918*** (2.607)	0.554*** (4.341)	1.398*** (4.014)	0.0008*** (6.621)	1.258*** (3.883)
Hausman test	241.369 (0.000)	19.772 (0.005)	69.922 (0.000)	184.397 (0.000)	- (0.000)	- (0.000)	- (0.000)	- (0.000)
Sargan over-identification test	9.769 (0.008)	90.692 (0.000)	39.476 (0.000)	4.580 (0.101)	- (0.000)	- (0.000)	- (0.000)	- (0.000)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports the simultaneous equation and instrumental variables for two-stage least square regression in the equation with the control variables. The instrumental variables are exogenous, including the business cycle prospect score and consumer confidential index and we also split the corporate governance index by 6 to enhance the main effect on the relation between CEOPAY, CGI and idiosyncratic volatility and information flow trading

***, **, and * denote statistical significance at the 1, 5, and 10 % levels, respectively. The test is one-tailed when directional predictions are made and two-tailed otherwise

economically significant. Setting all control variables at their mean values and moving the variables from zero to inclusion increases idiosyncratic volatility by 25.9 %, from 3.353 to 4.523.

4.4 Inclusion of related-party transactions and the effects on CEO compensation with stock volatility

Pooling OLS regression is used to test the cross-sectional data because of a lack of transaction records for every year in those listed firms. Table 7 indicates that the related-party transactions show a conflict of interest between dominant shareholders and minority shareholders. This serious agent principal–principal problem causes less information transparency in relation to idiosyncratic volatility. Jensen and Meckling assumed that models where a manager receives the full benefit of the transaction and bears the full cost of opportunistic consumption of corporate assets enable us to explore differences in private information in related-party transactions. The second column in Table 7 shows that related-party transactions drive positive information flow rather than volatility (2.268 vs. 0.587), which indicates that, the more related-party transaction between affiliated-firms, the greater the probability of private information trading in the stock market.

4.5 Moderating effect on the relationship among idiosyncratic volatility, CEO compensation and corporate governance

Table 8 tested the interaction of CEO compensation with two variables specific to the Taiwanese firms. The interaction of coefficient of related-party transaction with CEO compensation was significant. The results support the proposition that explains more influence than the main effects model. The results for the independent and moderate variables absorb the main effects of the limited-data over the 2002–2012 period in Taiwan. The interaction term between CEOPAY and CFR_VR has a significantly negative coefficient in the pooling OLS model. This result is also consistent with the theoretical argument of Wright et al. (2002), related to the effects of the external governance factors on CEO compensation upon the monitoring activities. This result provided some support for Hypothesis 4, suggesting that the greater the interaction term between CEOPAY with RPT, the more private benefit hold by dominants shareholders, the greater volatility for firm-specific event in the prediction. Otherwise, related-party transactions have negative effects to reduce the volatility and information flow trading. On average, the CEO compensation multiplied by the related-party transaction gives us the value of 0.2536 ($11.688 \times 0.0314 \times 0.691$), and RPT with individual effect reduces this by about 0.0397. The main effect still has a significant impact on the positive volatility. The results for CEO compensation with CFR_VR show that when the CEO reduces risk-taking behavior to cater to the dominant shareholders, the interaction effects are significant for both the negative impact on the idiosyncratic volatility as well as the positive main effect. We obtain a negative value (−0.0365) for volatility. The results strengthen the findings of Wright et al. (2007), suggesting that a higher proportion of incentives devoted to market prices relative to fixed salary tends to be

inversely associated with subsequent firm risk taking. All the entrenched effects of dominant CEOs or the expropriation effects of dominant shareholders enlarge the stock volatility and help information trading in the Taiwanese stock market. We conclude that CEOs with private information induce stock volatility and that dominant shareholders also strengthen risk adverse behavior, acting to reduce the profit objective for CEO decisions.

4.6 Inclusion exogenous variables and the simultaneous effect

Another concern with our main analysis is be that CEO compensation is influenced by the economic characteristics of the firms, with corporate risk-taking being one of these characteristics. For example, business fluctuation could lead to the maintenance of a higher volatility resulting in less CEO compensation leading to the exacting of higher private benefits (where equity-based compensation is less than cash remuneration). Alternatively, dominant shareholders may retain diversification over connected-firms that will take less risk (because private benefits are hidden in investments in internal capital markets). Given the potential for endogeneity, firms with good performance choose good governance mechanisms. In Table 8 shows the joint determination of two systems of simultaneous equations that treat CEO compensation and corporate governance index.

The estimation is performed using a two-stage procedure like the one followed by Black et al. (2006), and Guedhami et al. (2009); see Table 9. We find that the business-cycle-prospect scores and consumer confidence indexes are correlated with CGI and CEO compensation in the first stage (unreported), indicating business fluctuation and systematic risk in the simultaneous equation and two stage least square regression.

We find that the results are consistent with our hypothesis, except for the insignificance related to PIN regarding CEO compensation and CGI, as shown in Table 8. This paper considers models with predetermined instrumental variables that are uncorrelated with the main evidence on the impact of CEO compensation on idiosyncratic volatility and information trading. When we regress the residuals of the 2SLS regressions on the instrument and control variables, we find that the independent variables are jointly insignificant, further suggesting that the instrument variables are exogenous. The coefficient of CGI increases from 0.036 ($t = 2.587$) for panel data with fixed effect to 0.558 ($t = 4.341$). This is consistent with causation running from the portion of CGI that is predicted by exogenous variables including business cycles, prospectus scores and consumer confidential indexes instead of the environmental variance. This implies that, for risk-taking decision firms, higher entrenchment leads to higher idiosyncratic volatility (information flow trading) in the face of greater environmental uncertainty.

If the portion of CGI (that is due to the rules governing large firms) predicts higher idiosyncratic volatility and information trading, this could be an endogenous problem. We therefore use the average CGI score (1 for over 6, 0 for below 6) as an instrument for CEO compensation. A problem with this instrument is that CGI can directly influence the dependent variables. To address this concern, we employ regression discontinuity analysis adapted from environmental variables. The effect

of CEO compensation on the business fluctuations that apply to entrenched firms or expropriated ownership firms can be safely said to be exogenous. The toughest question for instrument validity is whether the CGI dummies predict idiosyncratic volatility only indirectly, through CGI, or indirectly. To begin with, CGI has a strong positive relation with idiosyncratic volatility in panel data with fixed effects (Tables 4, 5) and in the second stage of 2SLS (Table 9). This suggests that the positive relation idiosyncratic volatility reflects the effect of the CGI dummy on CEO compensation, which in turn affects idiosyncratic volatility, rather than a direct effect of the CGI dummy on idiosyncratic volatility. This would simultaneously expand so as to posit a positive relationship between CEO compensation and idiosyncratic volatility, leading to information flow trading for higher entrenched (expropriated) firms, which reverses the sign at precisely the score, where there is stronger risk adverse behavior (or lower risk-taking) and greater idiosyncratic volatility in spite of the higher equity-based compensation to fixed income.

5 Conclusion and suggestions for future research

In this study, using a unique database of 806 listed firms from Taiwan, we investigate the impact of private benefits and corporate governance on corporate risk-taking, where we measure private information using the idiosyncratic volatility and several proxy variables for information flow trading during the period of 2002–2012. Corporate risk-taking behavior is important as it is fundamental for dealing with the agent principal–principal problem related to CEO entrenchment or expropriation by dominant shareholders.

The panel data model with fixed effects tends to show a negative association between a higher proportion of incentives (equity-based calculation of compensation to fixed income) with idiosyncratic volatility and information flow trading. We expected and found that managerial entrenchment effects are directed and uniformly related to firm-specific risks, which is similar to the findings of Wright et al. (2007). Focusing on party-related transactions, the samples are condensed. We find inverse affects among CEO compensation with private information, indicating a positive relationship between volatility and information trading with related-party transactions. With dominant shareholders, this leads to risk-taking decisions for enhanced-value projects, because of non-profit objectives, evidence of expropriation thinking.

Our findings explain CEO hubris, defined as a CEO's exaggerated self-confidence or pride (Hayward and Hambrick 1997; Hiller and Hambrick 2005; Li and Tang 2010). Although CEOs might indulge in risk-taking decisions in regards to firm performance and survival from hubris (Sanders and Hambrick 2007). This paper examines corporate governance index and equity-based CEO compensation that influence the volatility of taking-risk decision in order to their own benefit from related-party transactions, strengthening entrenched effects or expropriation effects by dominant shareholders. Therefore, information flow trading and idiosyncratic volatility will be incurred by managerial discretion (Sanders and Hambrick 2007; Li and Tang 2010).

These results highlight the moderating effect of managerial discretion, inclusive of several factors of divergence including cash flow rights to voting right and related-party transactions given the known CEO incentive design and conditional entrenchment. The results demonstrate that organizational complexity and diversification provide CEOs with more private benefits. This serves to strengthen the positive relationship between CEO compensation and idiosyncratic volatility. We conclude with a suggestion that firms that have more intangible assets, and more innovation input, will benefit from enhancing managerial discretion so as to reduce the information asymmetry between firm performance and market expectations.

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