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What drives corporate insurance demand? Evidence from directors' and officers' liability insurance in Korea

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ABSTRACT

This paper provides empirical evidence that increasing risk results in higher demand for hedging among firms. Through a natural experiment exploring the Korean Government's legislative change on shareholder class action, I show that firms increase the liability insurance coverage for their directors and officers in response to increased litigation risk, despite the increase in costs associated with buying further coverage. I further test the heterogeneous effects in two dimensions of corporations: industry classification, and type of shareholder-management relationship. The results confirm that firms in high litigation risk industries and those with high agency conflicts between shareholders and management increase their insurance coverage relatively more. Overall, the results demonstrate that corporations adjust their hedging demand in response to changing risk environment and that the adjustment depends on the level of risk exposure of individual firms.

1. Introduction

Modern corporations purchase substantial amounts of insurance. As a result, more than 50% of insurance premiums are paid by businesses. By purchasing corporate insurance, companies aim to hedge risks and achieve maximization of firm value. While a substantial volume of academic studies focus on the relationship between hedging and firm value (Campello et al., 2011; Froot et al., 1993; MacMinn and Garven, 2000; Perez-Gonzalez and Yun, 2013; Stulz, 1984), little attention is paid to whether the presence of risk motivates companies to demand higher hedging, and whether companies react to the changing risk environment flexibly and promptly by adjusting their demand for hedging. In this paper, I primarily focus on showing a causal relation between risk and corporate demand for one of the hedging tools, corporate insurance. In addition to the main findings, I explore the cross-sectional heterogeneity in corporate demand for insurance based on two aspects of companies: industry, and the shareholder-management relationship. Inquiring into the heterogeneity in insurance demand adds to the literature that focuses on identifying the channel leading to higher demand for insurance among firms (Mayers and Smith, 1982).

To identify the causal effect, I set up an experiment using the introduction of the shareholder class action law in Korea and the purchase of liability insurance for directors and officers (D&O insurance) by Korean companies. Korean data provide a unique opportunity to run a natural experiment with one group of firms experiencing exposure to a higher risk of litigation, and other groups remaining in status quo during the process of a change in corporate law. The Korean government decided to allow shareholder class action for public firms having assets over 2 trillion Korean Won[1] (KRW) from 2005, and extend this to all publicly listed firms from 2007. Shareholder class action allowed even minority shareholders to instigate litigation against the firm in which they had invested or against its board of directors, unlike the earlier shareholder derivative suit which allowed only significantly large shareholders to

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[1] Approximately USD 1.9 billion at the 2005 exchange rate.

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institute litigation. Further, a court ruling in one case was made applicable to all shareholders experiencing the same type of damage, unlike before, when each aggrieved shareholder had to raise individual lawsuits to be compensated for identical incidents. Therefore, for firms subject to the law, the introduction of shareholder class action law implied a clear exogenous increase in risk of shareholder litigation, as well as litigation costs. Companies can cover this legal risk to some extent by purchasing D&O insurance. D&O insurance is a corporate insurance cover against litigation costs and losses, in the event that the directors or officers or the corporation itself is sued by stakeholders. Although various stakeholders, for example, shareholders, employees, suppliers, or consumers, can file lawsuits against their company's wrongdoings, most litigation issues are raised by shareholders on financial market matters. Therefore, although D&O insurance covers a wide range of litigation, it is primarily linked to shareholder litigation risk and can be used as a hedging tool against shareholder class action. The two-year window of 2005 and 2006, when only one group of firms could be bound by this law, provides a natural experimental setting for comparing the insurance demands between the two groups of firms above and below the asset threshold of KRW 2 trillion. This set up is particularly useful in exploring corporate demand for and adjustment of D&O insurance coverage as a response to changing litigation environment given that there is little concern for the anticipation effect often found in policy change based studies. For example, even though companies could anticipate from 2003, that the law will become effective in 2005, they may not have felt the need to increase insurance coverage from 2003 itself, given that the litigation risk was to increase only when the law would become effective in 2005.

By exploiting this legal change, which posed a litigation risk shock to some firms for the specified two-year period, I develop a differences-in-differences (DID) model and test whether the increased litigation risk results in increased demand for D&O insurance in large firms. The results from the DID model show that firms increased their insurance coverage owing to the pressure of potential shareholder class action, despite the fact that the insurance premium increases more progressively for the additional purchase of insurance coverage. This provides evidence that concern for increased litigation risk is a source of corporate insurance demand.

I run two additional tests to address the concerns in the natural experiment. The first test uses a regression discontinuity design (RDD) restricting the sample to firms around the asset threshold of KRW 2 trillion. The exogeneity of introducing the law for only large firms is critical in this experiment. If other factors closely related to firm size increase the insurance demand among larger firms, the DID model results could be misleading. The RDD addresses such concerns by running the DID analysis with samples having more homogeneous firm sizes around the asset threshold. The second test involves replicating the main analysis by using the second event in 2007 when all firms were exposed to the class action law. I test whether the DID analysis shows meaningful increases in insurance demand among smaller firms (newly exposed firms) as well in 2007. If the additionally exposed set of firms shows the same pattern of increase in insurance demand in response to litigation risk, it confirms that the result is truly due to an increase in litigation risk rather than other possible coinciding factors. The results of both additional tests are robust, thus confirming that insurance demand arises from exposure to relevant risks.

In addition to the main findings, I explore the cross-sectional heterogeneities in D&O insurance demand to further identify the channels leading large companies to higher demand for D&O insurance. I choose to examine two aspects of firms that could change the level of litigation risk exposure: industry, and the shareholder-management relationship. The type of industry a firm belongs to is a strong predictor of the probability of a firm being involved in lawsuits, and hence, is a frequently used proxy for litigation risk level (Kim and Skinner, 2012). I classify firms into two groups, one of relatively high legal risk industries, and the other of low legal risk industries, and run the main specification regression for each sample. By testing whether insurance demand varies according to industry type, I find that firms with potentially higher exposure to risk react more sensitively to an increase in risk. The shareholder-management format is also a proxy for the level of exposure to shareholder litigation risk. When management and ownership are separated, as in companies with hired CEOs, firms are more likely to experience agency conflicts and information asymmetry between shareholders and managers, and this may give rise to a higher probability of shareholders experiencing ex post disagreement or resentment on important management decisions, and hence to a higher probability of litigation. I divide the sample into two groups for split sample regression, one with owner-CEOs[2] that may suffer less from such agency conflicts, and the other with hired CEOs. By observing the ownership-management format and its influence on insurance demand, I test whether the demand for D&O insurance varies with the degree of agency cost. The results show that firms in the group of high litigation risk industries tend to react more strongly to exogenous changes in litigation risk, and firms with relatively lower agency conflicts between shareholders and management do not react as much as those that suffer from high agency costs. Cross-sectional heterogeneity tests identify the channels that lead companies to higher insurance demand. Both, the industry and shareholder-management relationship tests, commonly indicate that firms with higher probability of litigation react more sensitively to an exogenous litigation risk shock and demand for D&O insurance.

This study makes two major contributions to the literature. First, it provides empirical evidence of a causal relation between firm risk and corporate insurance demand, and proves that risk is a robust source of corporate insurance demand. The exogenous shock on the Korean D&O insurance data allowed the identification of such a causal relation. Second, by further utilizing the empirical set-up, it identifies some of the possible channels driving corporate insurance demand that were often considered a correlation in previous studies.

The rest of the paper is structured as follows. Section 2 reviews the related literature on corporate insurance demand. Section 3 first provides the institutional background for shareholder class action law in Korea and D&O insurance, and then describes the data of Korean firms studied, including their insurance purchase, and explains the empirical design of the DID model. Section 4 presents the results derived from DID analyses. Section 5 concludes the paper.

[2] A CEO is defined as the owner of a firm if he or she is one of the three largest shareholders.

2. Related literature

The positive effect of hedging company risks on firm value is shown in both, theoretical frameworks and empirical studies. In the theoretical literature, Stulz (1984) and Froot et al. (1993) develop models showing that value-maximizing firms engage in active hedging. In empirical literature as well, many studies on the link between hedging and firm value find a positive relationship. Allayannis and Weston (2001) show that the market value of firms increases with active risk management. Hoyt and Khang (2000) find that corporate insurance mitigates the underinvestment problem, promoting efficiency in real services, reducing the tax burdens of corporations, and reducing bankruptcy costs. More recently, Perez-Gonzalez and Yun (2013) establish a causal effect of risk management on firm value using instrumental variables.

Given the positive effect of hedging on firm value, firms are required to closely monitor the methods and amount of hedging they undertake to cope with the risks they are exposed to. This also implies the need for an appropriate adjustment when the level of risk changes. However, empirical evidence on the reaction of firms to a change in risk environment is sparse. A limited number of studies show a link between risk exposure and firm hedging activities. Among earlier works, Mayers and Smith (1990) find that default risks are significantly associated with corporate insurance demand. On the other hand Perez-Gonzalez and Yun (2013) show that a relatively higher exposure to risk is correlated with firms' extensive use of hedging. However, the findings remain at the correlation level and lack the understanding of whether risk drives the demand for corporate hedging.[3] The primary goal of this paper is to provide clear empirical evidence that an increase in risk leads firms to demand higher hedging. In other words, it will show whether firms react to a change in risk environment by adjusting their hedging policy in a timely manner.

This study focuses on a specific type of hedging tool, namely, corporate insurance, and whether firms adjust their demand for insurance when relevant risk environment changes. More specifically, I focus on D&O insurance, a type of corporate insurance covering the litigation costs and losses when a firm or its board of directors is sued by the stakeholders. When a management decision brings unfortunate results to a firm its directors and officers face the risk of being sued by stakeholders for overlooking their fiduciary duties. In such cases, the directors and officers become personally liable for the losses incurred due to their presumably careless management. However, because it is hard to expect value maximization when the directors and officers are excessively careful and risk averse (Gormley and Matsa, 2016) corporations agree to provide hedging for such liabilities should litigation happen, and often the litigation costs and damages are covered by D&O insurance that a firm purchased ex ante. Given that this is a tool to hedge the litigation risks of a firm, its demand should be adjusted considering the level of litigation risk that firms have to face.

Some of the previous literature investigates the effect of D&O insurance purchase by firms on their value. Janjigian and Bolster (1990), who investigate the impact of the legislation that allowed D&O insurance in Delaware, find that D&O liability elimination was benign since the abnormal return of Delaware corporations upon the introduction of legislation was positive. Brook and Rao (1994) show that there is no evidence of negative effect on shareholder value caused by the elimination of liability. They confirmed that the use of D&O insurance eventually benefits shareholders by showing that the net benefit of D&O insurance is larger for financially troubled firms than for other firms. Boyer (2014) shows that insurance protection increases when shareholders' risk level goes up and concludes that D&O insurance is used by shareholders to protect their own wealth as a precautionary preparation for managerial incompetence. Bradley and Chen (2011) also show that firms that provide limited liability and indemnification for their directors have higher credit ratings and lower risks. These studies show that insurance as a hedging tool contributes to firm value maximization and imply that an appropriate purchase decision is required among firms.

Another thread of extensive discussion on D&O insurance concerns the structure of the insurance contract as a signal of the quality of corporate governance and the likelihood of litigation. A D&O insurance contract that is negotiated between a firm and an insurer is considered to contain information on various governance issues of purchasing firms, such as managerial protection, litigation risk, and risk management. This is because insurance companies, which undertake the risk to indemnify litigation costs and damages, have enough incentives to thoroughly investigate the corporate governance risk of purchasing companies before agreeing on the insurance premium (Griffith, 2006). In previous studies, it has been both, qualitatively (Baker and Griffith, 2006, 2007) and quantitatively (Core, 2000) proved that insurance firms price D&O insurance contracts based on a variety of corporate governance factors. Gillan and Panasian (2014) also show that the Canadian firms with higher litigation risk exposure, such as cross-listing in the US and increased disclosure complexity, tend to pay higher insurance premiums. Boyer and Stern (2012) also show that D&O insurance premium varies with ownership structure that is a proxy for litigation risk.

The third strand of the D&O insurance literature, that is most relevant to this study, investigates drivers of insurance demand. Most studies focus on the firm characteristics that are closely linked to litigation risk and study whether insurance demand is driven by them. This can be seen partly as an effort to analyze whether insurance demand is driven by the level of litigation risk that are proxied by these characteristics. The characteristics that are studied most often for D&O insurance demand include industry, performance, and agency conflict. Core (1997) find that firms with greater distress probability purchase high coverage, presumably due to high litigation risk they are facing, while firms with greater inside ownership are less likely to purchase the insurance given that they suffer from lower agency conflicts. Gillan (2006) and Danielson and Karpoff (1998) assert that firms may need to adjust managers' risk-taking levels by purchasing D&O insurance protection when managers experience incentive to be overly-risk averse in high litigation risk environments, which may result in distorted decisions by firms. Lee and Choi (2006), who empirically test the determinants of D&O insurance purchase, show that both greater litigation risk and higher agency costs are associated with insurance demand. In all empirical studies on the demand of insurance, the industry membership is considered an important factor. This is

[3] The causal relation in Perez-Gonzalez and Yun (2013) is between hedging and firm value, rather than between risk and hedging.

following Francis et al. (1994) who provide a list of industries that are characterized by higher litigation risk[4] and show that industry membership is a key predictor of litigation in a firm.

However, whether firms adjust their D&O insurance sensitively to the relevant risk, which is the most fundamental reason for insurance purchase, is not clear from previous studies. Although a few previous studies test the direct link between insurance demand and litigation risk (Griffith, 2006; Lee and Choi, 2006), the ambiguity of the causal relation between insurance demand and risk level persists. Moreover, one cannot clearly define whether the factors pointed to as determinants affect insurance demand directly or indirectly through their impact on firms' risk levels. Primarily, it is because there is no direct measure of litigation risk available to researchers. More importantly, it is due to the difficulties in dealing with endogeneity issues regarding litigation risk and corporate insurance demand. A clear conclusion can be drawn on litigation risk and insurance demand only when an exogenous variable affects the litigation risk level. I achieve this using an exogenous shock found in Korean data. Similarly, although industry and agency costs have been studied previously, their causal relation with insurance demand is less well established. The quasi-experimental set-up of this paper can remedy the problem of unclear identification of causation. After confirming the main findings on risk and insurance demand, I revisit the issue of firm characteristics and empirically test whether firms' demand for corporate insurance varies by industry membership and ownership format. By extending the analysis to differences in insurance demand by industry type and shareholder-management relationship, I further explore the possible mechanisms that drive corporate insurance demand.

3. Data and empirical design

3.1. Institutional background

By running a company on behalf of its shareholders, the directors and officers of the company have a fiduciary duty to the shareholders, as well as to the corporation itself. The requirement of a fiduciary duty assumes that the directors and officers must act in good faith and honesty, and in the best interests of the corporation. They must not practice self-dealings, usurp corporate opportunities, or pursue improper personal benefits. However, this is a provision that is sometimes hard to observe objectively in execution. Thus, directors and officers carry the risk of being sued by stakeholders who may believe that they may have defaulted in their duties. This usually happens when the management's decision leads to unfortunate results. In such cases, the directors and officers become personally liable for the losses caused by their presumably careless management. Although personal liability plays a role in monitoring directors and officers, it may also induce risk-aversion among them. To avoid the possible excessive care by directors and officers, corporations can indemnify such liability by various means. Ex ante, it can limit the degree of the duty of care. Ex post, shareholders can approve the indemnification or reduction of the liability burden of directors and officers. The cost of the latter can be lighter when corporations purchase D&O insurance, which will cover the damages that the directors and officers are asked to pay.

This arrangement by which corporations purchase insurance and protect their directors and officers may appear unusual, given that removing the liability of managers can give rise to a moral hazard problem among managers. Previous studies have pointed out that in addition to the fact that D&O insurance incentivizes managers to take more risk in business decisions, it also contributes by attracting highly qualified managers to executive jobs of the insurance-providing firms, as well as by protecting corporate assets while self-seeking managers cause litigation damages to the firm (Core, 1997; Griffith, 2006). Further, each firm's D&O insurance contract is priced by insurance companies after undertaking a thorough check of the firm's litigation risk, and therefore the price of insurance also gives outside shareholders valuable information on the quality of the firm's corporate governance (Griffith, 2006). Such benefits explain the widespread purchasing of D&O insurance in countries with well-developed financial markets. For example, more than 90% of US firms purchase such insurance, and the demand is growing fast in countries such as Korea and China, where it was introduced relatively recently.

In Korea, the high increase in D&O insurance purchase was triggered by two shareholder derivative suits filed against the directors of Korea First Bank (KFB) and Samsung Electronics in 1997 and 1998, respectively. These were the first shareholder suits in Korea that were ruled in favor of Korean shareholders. Following these two landmark lawsuits, corporations recognized the importance of D&O protection and started to purchase insurance.[5] When the Korean government introduced shareholder class action on January 1, 2005, the risk of litigation by shareholders went up for the firms subject to the law, and the importance and usefulness of D&O insurance was highlighted in media once again.

Discussions on the adoption of shareholder class action law started in 1998, when the International Bank for Reconstruction and Development (IBRD), which provided Korea with recovery funds during the Asian Financial Crisis in 1998, strongly recommended it. When the country was under scrutiny of the IBRD, so as to be provided with financial help, the disclosure and transparency standard in Korean companies was remarkably low. Therefore, the IBRD strongly recommended the adoption of shareholder class action in addition to corporate governance reform for Korean companies. The main reason was that the granting of strong rights to shareholders can prevent corporate misbehavior and improve the quality of corporate governance.

[4] This list includes biotech firms (pharmaceutical industry), computer firms (high-tech industry), electronics firms, and retail firms.

[5] In 1997, the People's Solidarity for Participatory Democracy (PSPD), a public interest group, initiated legal action against some former officers of the KFB. On behalf of 61 minority shareholders of the bank, the plaintiffs claimed KRW 40 billion in compensation for the decision of the management to provide credit to the failed conglomerate, Hanbo. The Seoul District Court ruled in favor of the minority shareholders and issued an award of KRW 40 billion against the directors that had to be paid from their personal wealth. The second case followed a year later. In 1998, the PSPD filed another suit against the board members of Samsung Electronics. By charging the directors of various wrongdoings, including such illegal actions as bribery, they initially won KRW 97 billion as compensation, which was later reduced to KRW 19 billion after Samsung Electronics went on appeal. These were the first legal proceedings that brought up monetary liability for directors and officers in Korea.

The bill for shareholder class action was introduced by the Korean government in November 1998, but it could not proceed to the next level. The bill was resubmitted by an NGO in Korea in October 2000, triggering active discussion between the government, legal experts, business leaders, and the public on the matter. In spite of strong objections and concerns from corporate leaders at the beginning of the discussion, the Class Actions in Securities Act was eventually passed in December 2003. The law was implemented in a staggered manner. It first applied to companies with assets above KRW 2 trillion from January 1, 2005, and was then set to apply to all public companies from January 1, 2007. The introduction of securities class action was expected to greatly improve litigation efficiency because, earlier, a court's ruling was applicable only to the plaintiff shareholders and each shareholder had to initiate individual lawsuits even when the compensation was for the same kind of damage. Furthermore, the new law also lowered the shareholding requirement for shareholders to bring derivative lawsuits against the company's directors and officers. While the old law required 5% of shareholdings for all companies, the new law stipulated that fifty shareholders collectively owning 0.01% of shares can bring a lawsuit. For large companies with assets greater than KRW 2 trillion, the new shareholding requirement was further lowered to 0.005% (Black et al., 2010). The new law also granted shareholders better access to company records by lowering the shareholding requirement from 5% to 0.05% for large companies and to 1% for other companies.

After the introduction of the law, the first shareholder class action suit was raised in 2009 against Jinsung T.E.C. Inc., which is a heavy construction equipment manufacturer in Korea, due to the company's accounting fraud. Although it did not lead to a trial given that a compensation agreement was made between the shareholders (plaintiff) and the company (defendant), this case marked the first class action lawsuit in Korea. Since then, every year, on average, one to two shareholder class action lawsuits are raised against companies. Given that shareholder class actions can only be raised when the case is approved by the Court of Justice, it is true that if the attempts to raise litigations are also observed, the number is higher. Although it may not appear a very litigious environment based on the number of times litigation was raised, compared to the previous time period, the perceived litigation risk is likely to be higher from the companies' perspective. This is because the discussion on the new law not only made litigations easier but also promoted the awareness of the ability to raise a lawsuit as a shareholder. The introduction of class action law seemingly also had spillover effects on other types of shareholder suits. For example, before the introduction of the class action law in 2005, the number of shareholder derivative suits (litigation from individual shareholders) was on average 3.4 cases per year between 1997 and 2004 and it became average 7 per year between 2005 and 2008 even though the derivative suit was always available and was not affected by the introduction of the class action. Further, from the law society and law firms, there are efforts being made to develop more expertise in the shareholder class action lawsuits given that lack of understanding and expertise in this type of suits among legal experts is thought to be one of the reasons why litigation is still only weakly activated. Given this institutional understanding, this paper analyzes whether Korean companies choose to hedge their risks by purchasing D&O insurance covering litigation costs and damages when the risk of litigation went up.

3.2. Data description

For my analysis, I construct a panel data set of firms listed with the Korea Composite Stock Price Index (KOSPI) market. The KOSPI market is a benchmark stock market for Korea, where middle-size to large-size companies are listed. It is a well-functioning financial market attracting foreign investment from major developed countries as well as domestic investors. Its index, called KOSPI200, is one of the most actively traded stock market indices. Therefore, firms listed in the KOSPI market are considered to represent a sample of firms for analysis of public companies in Korea. I construct a list of all firms listed on the KOSPI market from 2000 to 2008 and collect their data. As of 2005, 702 firms were listed on the KOSPI market. From this list, I take the nonfinancial firms continuously listed on the market from 2000 to 2008. After dropping the firms with missing values for control variables, I am left with a balanced panel of 520 firms for 2000–2008.

I collect the variables from two different sources and combine them to construct the data set. First, I manually collect the D&O insurance and corporate governance-related control variables from each company's annual report. The annual report submitted by individual companies to the Financial Supervisory Service is the only source of these variables for Korean firms. For D&O insurance, I collect the insurance purchase dummy, insurance premium, and insurance coverage variables. I gather corporate governance variables from the annual reports related to board independence (the proportion of outside directors on the board) and board ownership (the number of shares owned by the company's board members). Second, I collect accounting variables from the Kisvalue database, the Korean business data provider. The accounting data include total assets, total liabilities, net income, return on assets, and stock prices. I also source ownership concentration data from the same database. The data from different sources are merged according to the unique company codes that are common in data sets.

For the analysis of the companies' insurance purchases before and after the class action law introduced in 2005, I define the pre-law period as 2002–2003 and the post-law period as 2005–2006. I exclude the data of 2004, the year prior to the actual enactment of the law, to avoid the complication that might be introduced owing to the possible difference in start and end dates of the individual firms' insurance contracts that are not disclosed. The reason for excluding 2004 is as follows. The purchase of D&O insurance is reported once a year as a part of annual report, but not the exact contract dates. Firms can purchase D&O insurance at any point during the year, and the contract covers the litigation risk for exactly one year, terminating a day before the date on which the contract was signed the previous year. Although class action law came into effect on January 1, 2005, its introduction date was planned from 2003. Thus, firms were aware in advance that they would be subject to the law from the first day of 2005. Further, with regard to litigation involving accounting fraud, the fact that shareholders could raise class action from the beginning of 2005 meant that accounting reports for 2004 could be subject to litigation (Byun, 2004). Thus, firms could reasonably be thought of as reflecting their concerns in insurance purchases one year ahead, in 2004. Indeed, several newspapers reported increased interest in and demand

for D&O insurance in 2004. Furthermore, insurance premiums tended to increase from 2004 because of high demand and the increased risks resulting from class action law (Byun, 2004; Choi, 2004, Lee, 2004). However, the data for the year 2004 has an issue. A contract signed in early 2004 would expire soon after the introduction of the new regulation, whereas a contract signed late in 2004 would be valid for almost the entire period of 2005. Since the data of the start and end dates of contracts for each company are not available, it is not clear whether firms, or rather which firms, reflected their litigation risk concerns in their insurance contracted in 2004. To avoid such possible issues in the data, I exclude data from 2004. The final time period used in the analysis is therefore 2002–2003 for the pre-law period and 2005–2006 for the post-law period. The total number of firms in the final data set is 520, among which 55 firms have total assets above 2 trillion Korean Won (treated) and 465 firms have total assets below the threshold (control). Among the treated, 45 firms already had D&O insurance before the introduction of the law and 10 firms did not. Among the controls, 86 had insurance before the law and 379 did not.

The key variables in the analysis are defined and explained in this section. The dependent and independent variables are as follows.

Insurance coverage In the main regression model, the dependent variable is the D&O insurance coverage that a company chooses to buy in a given year. It shows the maximum amount that an insurance company will have to cover in the case of litigation and is a continuous measure expressed in KRW. This is a direct observation of an individual firm's insurance demand. There may be over-insurance or under-insurance issues for a variety of reasons. However, based on the belief that firms carefully choose the level of coverage and also due to the impossibility of measuring issues such as these, I assume that the amount of coverage purchased in each firm best represents their demand for D&O insurance.

Insurance premium In the following regression model, the dependent variable is the D&O insurance premium that a company pays to buy the chosen level of coverage in a given year. It shows firms' willingness to pay to be covered with D&O insurance, and hence, the level of litigation risk felt by firms. It is a continuous measure in KRW.

Treat dummy The treatment variable is a dummy variable that identifies the firms that are subject to shareholder class action law from 2005. This takes a value of 1 if a firm has assets over KRW 2 trillion and 0 otherwise.

I include a range of control variables to account for factors that could potentially affect insurance coverage, and they are as follows.

Company size Mayers and Smith (1990) hypothesize that company size is negatively correlated with insurance demand because small firms are more concerned about costs and are less likely to have internal talent to manage them. However, focusing on D&O insurance demand, Core (1997) argues that larger firms are exposed to greater risk of litigation, and therefore have higher demand for insurance. He finds supporting evidence that larger firms purchase significantly higher insurance coverage. He also argues that only the fact that insurance coverage as a proportion of firm size decreases with larger firm size is consistent with Mayers and Smith (1990). Many other studies point out that firm size is an important determinant of corporate insurance demand (Core, 2000, Hoyt and Khang, 2000, Regan and Hur, 2007, Yamori, 1999; Zhu et al., 2011; Zou and Adams, 2006; Zou et al., 2003). Following previous studies, I define firm size in terms of total assets. To allow a more flexible (non-linear) relationship between insurance demand and firm size, I also include quadratic and cubic terms of assets in the regressions.

Debt ratio A higher debt ratio implies that the firm has less flexibility to respond to economic and business shocks and is more likely to experience conflicting interests between debtholders and equityholders (Regan and Hur, 2007; Yamori, 1999). This increases the risk of litigation and is therefore expected to induce firms to increase insurance purchase. The debt ratio is measured by the proportion of total liabilities to total assets.

Tobin's Q (growth opportunity) Compared to those in entities with fewer new opportunities, managers in higher growth opportunity firms have more decisions to make and are given greater discretion, and their decisions are less transparent (Smith and Watts, 1992). Therefore they are exposed to higher litigation risks and higher demand for D&O insurance. Growth opportunity is also a factor in agency conflict issues that increase the underinvestment problem (MacMinn, 1987, MacMinn and Garven, 2000; Mayers and Smith, 1982) and eventually result in high insurance demand. I used Tobin's Q to capture the growth opportunities of firms. Tobin's Q is defined as the ratio of the sum of the market value of equity and the book value of liabilities and the sum of the book value of equity and the book value of liabilities. The market value is calculated as the book value of assets minus the book value of equity plus the market value of equity.

Short-term financial stability and performance Short-term financial stability and performance are critical factors that predict probability of financial distress, which is closely linked to litigation probability (Core, 1997). Short-term financial stability is measured by cash holdings that include cash equivalents and quick ratio (Q ratio) which is the ratio of current assets less inventories to current liabilities. Performance is measured by net income, net profit, return on asset, and return on equity.

Stock volatility Annualized stock return volatility may indirectly influence litigation risk given that higher volatility has the potential to lead to stock price decline (Core, 1997), which is eventually associated with insurance demand.

Board size Literature suggests that corporate governance is associated with the D&O insurance purchase decision as well as its premium level (Core, 1997, 2000; Gillan and Panasian, 2014, 2015). Board size is one of the most basic factors in corporate governance that primarily measures the size of the firm and also measures implied degree of agency problem. Given the relationship between the firm size and insurance demand, the size of the board is likely to be positively associated with insurance demand.

Board independence As outside directors are exposed to similar litigation risks as inside directors are, while compensation is much lower, they have a strong preference to sit on a board where their activities are insured by D&O insurance. In line with this, many previous studies (Baker and Griffith, 2007; Core, 1997) argue that companies purchase D&O insurance to attract talented independent directors. Board independence is measured by the proportion of outside directors in the total number of board members. When a larger proportion of board members are independent directors, there may be higher demand for insurance.

Table 1
Variable definitions.

Variables	Definitions
D&O Insurance Coverage	The maximum amount that the insurance company will have to cover in case of litigation.
D&O Insurance Premium	The cost of insurance.
Treat Dummy	A dummy variable identifying the firms subject to the shareholder class action law from 2005. 1 if a firm has assets over KRW 2 trillion in 2005 and 0 otherwise.
Company Size	Measured by total assets
Debt Ratio	Total liabilities over total assets
Tobin's Q	The ratio of the sum of the market value of equity and book value of liabilities to the sum of the book value of equity and book value of liabilities. Market value is calculated as the book value of assets minus the book value of equity plus the market value of equity.
Short-term Financial Stability	Measured by cash and cash equivalents (short-term liquid assets) and quick ratio (Q-ratio) defined by the ratio of current assets less inventories to current liabilities.
Performance	Measured by net income, net profit, return on asset, and return on equity.
Stock Return Volatility	Annualized stock return volatility
Board Size	Number of directors on board.
Board Independence	The proportion of outside directors in the total number of board members.
Board Ownership	The percentage of company ownership held by the board members.
Ownership Concentration	The sum of the three largest shareholders' stakes.

Board ownership The size of the stake held by the board can influence insurance demand just as ownership concentration may influence insurance demand. In general, the board makes important decisions including those related to the purchase of insurance. If their stake in the firm is large, there are fewer opportunities for them to diversify their portfolio, and they are exposed to company risks (Mayers and Smith, 1982). Therefore, the larger the ownership stakes of the board, the greater the demand for insurance. On the other hand, large shareholders are assumed to have resources and motivations for intensive monitoring, decreasing the probability of being sued. Therefore, they might not need so much insurance. In this case, insurance demand is lower in firms with concentrated ownership.

Ownership concentration Many corporate insurance theories argue that if shareholders can hold well-diversified portfolios, insurance purchases for specific firms are unnecessary from their point of view (Mayers and Smith, 1982; MacMinn, 1987). Therefore, how concentrated a firm's ownership is signals how many of its shareholders are exposed to firm-specific risks. The more concentrated a firm is, the higher the expected demand for insurance. However, for this specific type of insurance, if concentrated ownership implies improved monitoring of management and lower possibility of managerial misbehavior, it may mean lower insurance demand from concentrated firms. I define ownership concentration as the sum of the three largest shareholders' stakes.

Table 1 provides the definition of the variables and Table 2 provides the summary statistics of the sample firm characteristics.

3.3. Empirical design

This study employs the DID model where class action law is an exogenous and heterogeneous treatment to which only firms with total assets over the threshold of KRW 2 trillion are exposed. I graphically test whether the movements in insurance coverage were parallel in the two groups of firms (exposed and not exposed) before introduction of the class action law. I present the results in Section 4.1 which shows fairly parallel movements in insurance coverage before the law. From this, I assume that the expected changes in insurance coverage would have followed a parallel trend in the two groups of firms in later periods had the law not been enacted and, construct a DID model accordingly.

The base DID model is as follows:

$$\Delta Coverage_i = \alpha + \beta \cdot TreatDummy_i + \gamma \cdot \Delta I_i + \epsilon_i, \tag{1}$$

where

$$TreatDummy_i = \begin{cases} 1 & \text{if} \quad TotalAssets \geq 2 trillion KRW in 2005 \\ 0 & \text{otherwise.} \end{cases}$$

Cov_i is the amount of insurance coverage purchased by firm i. $TreatDummy_i$ is a dummy indicator showing whether firm i has an asset size that exposes them to shareholder class action, and is equal to 1 if the firm has assets over the threshold. I stands for the control variables.

$\Delta Coverage_i$ which is the dependent variable in the regressions stands for the difference between average Cov_i in the post-period and Cov_i in the pre-period. I adopt the use of this variable following Bertrand et al.'s (2004) suggestion to address the serial correlation concern in using the DID model for multiple years of panel data. They suggest taking the average of the variables before and after the treatment and run regressions with the averaged variables. By using the averages, I can discount the time-series information in computing the standard errors and thus avoid possible serial correlation problems. According to Bertrand et al. (2004), this simple solution works when laws are passed at the same time for all treated individuals, and my data set meets this condition. Therefore, both, the outcome and independent variables in Eq. (1) are summarized in single numbers representing the change between the averages of the variables in the pre-class action law period and post-class action law period. Therefore, this variable captures any increase or decrease in insurance coverage between the pre-period and post-period as well. The calculations are as follows:

Table 2
Summary statistics.

	All sample		Treatment		Control	
	Mean	SD	Mean	SD	Mean	SD
Total Assets (bn)	1220.03	4307.49	8570.93	10,734.44	370.11	655.61
Total Liabilities (bn)	614.37	1854.96	4289.02	4078.47	189.50	420.55
D&O Insurance Purchase Dummy	0.31	0.46	0.85	0.36	0.25	0.43
D&O Insurance Premium (bn)	0.25	0.75	0.70	1.30	0.07	0.09
D&O Insurance Coverage (bn)	6.88	16.71	27.86	31.84	2.69	5.21
Debt Ratio	0.49	0.58	0.56	0.19	0.49	0.61
Tobin's Q	0.96	0.72	1.10	0.39	0.94	0.75
Cash Holdings over Total Assets	0.05	0.06	0.04	0.04	0.05	0.06
Net Income over Total Assets	0.03	0.44	0.04	0.09	0.03	0.47
Net Profit or Loss over Total Assets	0.03	0.51	0.04	0.08	0.03	0.54
Q-Ratio	1.31	1.21	0.74	0.44	1.38	1.25
ROA	0.03	0.10	0.04	0.08	0.02	0.10
ROE	0.05	0.31	0.08	0.26	0.04	0.32
Stock Return Volatility	58.71	22.97	53.81	19.20	59.27	23.30
Board Size (n)	7.39	2.54	9.64	3.05	7.13	2.34
Board Independence (%)	26.87	13.99	52.45	11.75	23.92	10.87
Board Equity Ownership (%)	6.67	12.19	4.37	8.18	6.93	12.54
Ownership Concentration (%)	40.41	15.99	37.66	15.51	40.80	16.02
Observations	4706		487		4219	
	Panel A: Treatment					
	Treatment		Pre-period		Post-period	
	Mean	SD	Mean	SD	Mean	SD
Total Assets (bn)	8570.93	10,734.44	7389.07	9264.37	10,005.27	12,152.95
Total Liabilities (bn)	4289.02	4078.47	4003.95	3811.45	4635.00	4364.57
D&O Insurance Purchase Dummy	0.85	0.36	0.77	0.42	0.95	0.23
D&O Insurance Premium (bn)	0.70	1.30	0.70	1.23	0.69	1.37
D&O Insurance Coverage (bn)	27.86	31.84	18.57	23.84	39.13	36.42
Debt Ratio	0.56	0.19	0.60	0.19	0.51	0.19
Tobin's Q	1.10	0.39	0.99	0.35	1.24	0.39
Cash Holdings over Total Assets	0.04	0.04	0.03	0.04	0.05	0.04
Net Income over Total Assets	0.04	0.09	0.03	0.10	0.05	0.07
Net Profit or Loss over Total Assets	0.04	0.08	0.04	0.09	0.06	0.05
Q Ratio	0.74	0.44	0.68	0.38	0.90	0.53
ROA	0.04	0.08	0.03	0.09	0.05	0.07
ROE	0.08	0.26	0.07	0.32	0.09	0.18
Stock Return Volatility	53.81	19.20	58.36	20.32	48.49	16.32
Board Size (n)	9.64	3.05	9.87	3.35	9.36	2.62
Board Independence (%)	52.45	11.75	48.11	13.48	57.70	5.94
Board Equity Ownership (%)	4.37	8.18	3.93	7.43	4.89	8.97
Ownership Structure (%)	37.66	15.51	37.80	16.42	37.50	14.39
Observations	487		267		220	
	Panel B: Control					
	Control		Pre-period		Post-period	
	Mean	SD	Mean	SD	Mean	SD
Total Assets (bn)	370.11	655.61	310.08	382.52	442.59	873.39
Total Liabilities (bn)	189.50	420.55	166.97	257.14	216.70	556.18
D&O Insurance Purchase Dummy	0.25	0.43	0.19	0.39	0.31	0.46
D&O Insurance Premium (bn)	0.07	0.09	0.09	0.08	0.06	0.09
D&O Insurance Coverage (bn)	2.69	5.21	1.72	3.39	3.76	6.51
Debt Ratio	0.49	0.61	0.53	0.80	0.44	0.20
Tobin's Q	0.94	0.75	0.86	0.88	1.04	0.52
Cash Holdings over Total Assets	0.05	0.06	0.05	0.06	0.06	0.06
Net Income over Total Assets	0.03	0.47	0.04	0.62	0.02	0.13
Net Profit or Loss over Total Assets	0.03	0.54	0.04	0.63	0.03	0.14
Q Ratio	1.38	1.25	1.33	1.19	1.50	1.37
ROA	0.02	0.10	0.02	0.11	0.03	0.09
ROE	0.04	0.32	0.05	0.37	0.03	0.23
Stock Return Volatility	59.27	23.30	63.71	25.96	53.94	18.28
Board Size (*n*)	7.13	2.34	7.27	2.45	6.95	2.19

(*continued on next page*)

Table 2 (*continued*)

	All sample		Treatment		Control	
	Mean	SD	Mean	SD	Mean	SD
Board Independence (%)	23.92	10.87	22.01	10.47	26.23	10.90
Board Equity Ownership (%)	6.93	12.54	6.82	12.54	7.07	12.54
Ownership Structure (%)	40.80	16.02	40.17	16.83	41.31	15.33
Observations	4219		2311		1908	

This table reports summary statistics (mean and standard deviation) of firm characteristics for all sample companies in the first two columns and separately for treatment and control groups in the next columns. The values are expressed in billion Korean Wons, in percentages or in absolute numbers, depending on the nature of the variables. D&O insurance purchase dummy is 1 if a firm purchases the type of insurance. D&O insurance premium is the amount of premiums that firms pay to purchase insurance and D&O insurance coverage is the amount of coverage companies purchased in their insurance contracts. Both, premium and coverage, are treated as missing in cases where a firm does not purchase insurance, hence the value stands for average premium and coverage of those firms that purchased insurance. Debt ratio is calculated as total liabilities divided by total assets. Tobin's Q is the sum of market value of equity and book value of debt divided by the sum of book value of equity and book value of debt. Cash holdings, net income, and net profit or loss are scaled by asset size for size-considered comparison. CA/TA is the proportion of current to total assets. Q-Ratio (quick ratio) is defined as the ratio of current assets less inventories to current liabilities. ROA and ROE are return on assets and return on equity. Stock return volatility is the standard deviation of daily stock returns in each year multiplied by a square-root of the number of trading days. Board size is the number of directors on board. Board independence is the ratio of number of independent outside directors to total number of directors on board. Board ownership is the number of shares owned by board members as a percentage of the total number of shares outstanding. Ownership concentration is the sum of three largest shareholders' ownership as a percentage of the total number of shares outstanding.

$$\Delta Cov_i = \frac{1}{2}\sum_{t=2005}^{2006} Cov_{it} - \frac{1}{2}\sum_{t=2002}^{2003} Cov_{it}$$

$$\Delta I_i = \frac{1}{2}\sum_{t=2005}^{2006} I_{it} - \frac{1}{2}\sum_{t=2002}^{2003} I_{it}.$$

The same methodology is applied to all control variables I_i. By estimating the coefficient using the differences in all dependent and independent variables, I can control for any time-invariant and unobserved variables allowing the firm fixed effect to be incorporated in the regressions.

The classification of the control and treatment in this study depends on firms' asset size as of the first year of the law. This raises a concern that firms may manipulate their asset size to stay below the asset threshold. I check whether there are firms that presumably manipulate their size to be classified as control firms and avoid being exposed to the increased litigation risk. In the data set, I confirm there is no firm that had higher assets than the threshold before the law and turned to have lower than threshold after the law. It means that there is no firm in the treatment group that manipulated its assets to convert themselves into the control group. Additionally, there can be an issue if firms that had an asset size right below the threshold, manipulate their growth rate in such a way that it would prevent them from having assets above the threshold at the time of the enactment of the law. To check this, I calculate historical average growth rate using the data from the pre-law period, calculate the predicted asset values for the first year of the law, and check whether there are firms that grew less than their historical growth rate. With this analysis as well, I do not find such a firm which is presumed to have grown less intentionally. Hence, the classification of treatment and control is solely based on the asset sizes in 2005.

In the analysis, I first run regressions as in Eq. (1) for the entire samples, including the D&O insurance purchasing and non-purchasing firms. In the data set, D&O coverage is coded as 0 if the firm did not buy insurance that year. Therefore, if there were firms that started to buy insurance within the data period, this is captured in the variable. In addition to this, to see whether there was an increase in insurance demand owing to law change among the firms that had already purchased insurance, I also run regressions using the purchasing firms' data alone. Firms that bought D&O insurance throughout the four-year period are classified as purchasing firms.

In the next regression, which is the main specification I adopt for the rest of the analysis, I use the change in insurance coverage scaled by firm size as the outcome variable. I use this as the main specification because it better controls for the firm-size effect in insurance coverage. This could make the dependent variable less flexible. To minimize this issue, when I scaled insurance coverage by firm size, I used the total assets in 2005 to scale the coverage size for all other years. By not updating the asset size in the denominator of the dependent variable, I avoid the problem of the dependent variable being significantly affected by changes in asset size that may not be related to insurance demand. The main specification is expressed in the following equation:

$$\Delta\frac{Cov_i}{TotalAssets_{2005}} \times 100 = \alpha + \beta{\cdot}TreatDummy_i + \gamma{\cdot}\Delta I_i + \epsilon_i. \quad (2)$$

When insurance coverage changes due to increased demand, the premium charged for the insurance package may also change. To explore the effect on the pricing of insurance, I run the following model that has insurance premium as a dependent variable.

$$\Delta\frac{Prem_i}{TotalAssets_{2005}} \times 100 = \alpha + \beta \cdot TreatDummy_i + \gamma \cdot \Delta I_i + \epsilon_i. \quad (3)$$

The model's set up is the same as the main analysis of the study in Eq. (2), except that the dependent variable is replaced with $Prem_i$ which is the amount of insurance premium firm *i* paid to purchase the coverage. It is scaled by total assets to control for the firm size effect in the insurance premium.

In addition to the main analysis, I run two more tests that confirm the robustness of the findings. First, I employed the RDD, running the DID model with the samples around the asset threshold of KRW 2 trillion. This was to address the concern that the litigation risk shock may not be exogenous. For example, if there was non-measurable underlying demand for the law from the public, it could mean increasing interest among stakeholders on the possibility of initiating corporate litigation. This could have gradually increased the risks of other types of litigation even before the shareholder class action law was enacted. In that case, as litigation risks are likely to first increase for extremely large firms, there is a concern that the results could be driven by the heterogeneity of firm size in the control and treatment groups. By estimating the coefficients of Eq. (2) after excluding firms with asset sizes at each extreme, one can present a more precise causal relation between the law change and D&O insurance demand, given that the most important firm characteristic, firm size, diverges less in the two groups.

In the second test, I run the DID regression using the second event in 2007 when the law became applicable to all public firms. At the beginning of 2007, the control firms became newly exposed to the risk of shareholder class action whereas the treatment firms had already been exposed to the law for two years. If the law was the cause of the firms' increased demand for D&O insurance and the results in the main specification was not earned by chance, an additional experiment exploring the DID model using the expansion of the law should show significant increases of insurance demand for firms in the control group that were freshly exposed to the law. The results of this test should also confirm that firms adjust their insurance demand when they face exposure to increased litigation risk without anticipation or lagged effect. This is because the results mean that the treatment firms that already adjusted their demand for insurance two years ago would not adjust any further (no lagged effect) and that the control firms that already knew in 2003 that they would be exposed in 2007 decided to adjust their demand only when they were exposed, not beforehand (no anticipation effect). For this test, I define the pre-law period as 2004–2005 and the post-law period as 2007–2008, and convert *TreatDummy* to 1 if the firms are with assets below KRW 2 trillion as of 2005 (1 for firms that were previously classified as "*Control*").

In both additional tests, I adopted the main specification, where the dependent variable insurance coverage was scaled by total assets.

4. Results

4.1. Pre-trend analysis and t-test

For the DID models to be valid, there should be a parallel trend in the outcome variable between the treatment and control groups in the pre-treatment period. Fig. 1 shows the results of the test on whether the trend in insurance demand in the two groups of firms was parallel before 2004. As D&O insurance coverage is greatly affected by firm size, the y-axis variable (D&O insurance coverage) is scaled by firm size proxied by total assets. The scaling is justified further by the Fig. 2 which plots the absolute amount of coverage in the two groups of firms and shows that absolute amount may not be visually comparable due to the firm size effect. The graph in Fig. 1 presents the trends in scaled insurance demand for two groups of firms, one with assets above KRW 2 trillion (large) and the other with assets below KRW 2 trillion (small). As shown in the graph, the trend is parallel up to 2003, but starts to diverge from 2004, the year the shareholder class action law was supposed to start affecting the large firms' exposure to litigation risk. The demand appears higher for large firms in 2004 and 2005, as the hypothesis predicts. Further, there was higher insurance demand from small

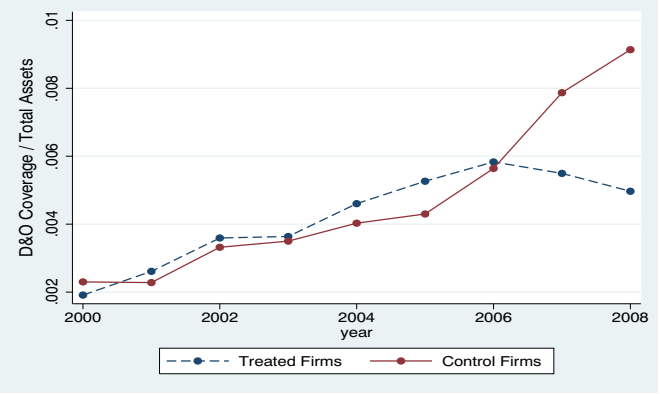

Fig. 1. The graph plots the yearly average of D&O insurance coverage scaled by the total assets for the treatment and the control group in sample in the period 2000–2008. The blue line in the graph shows average D&O insurance coverage for *Treat* firms and the red line for *Control* firms. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

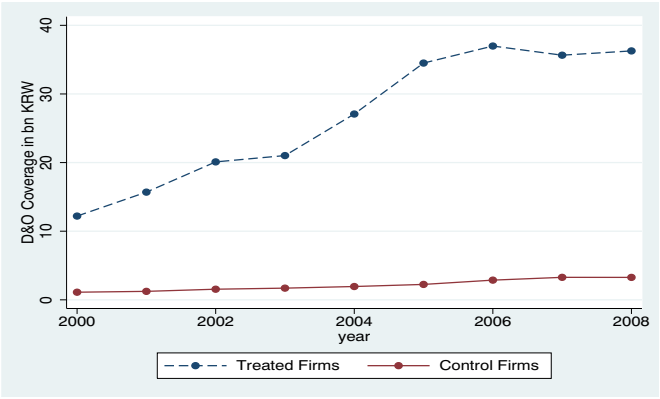

Fig. 2. The graph plots the yearly average of D&O insurance coverage for the treatment and the control group in sample in the period 2000–2008. The blue line in the graph shows average D&O insurance coverage for *Treat* firms and the red line for *Control* firms. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

firms from 2006 as the law became effective for all public firms.[6] From the graph, I conclude that using the DID model is viable with the data set.

In addition to the pre-trend analysis, I also test whether firms in the treatment and control groups are significantly different with their firm characteristics that are likely to affect D&O insurance demand through a *t*-test. This is to ensure that the results are driven by treatment rather than other variables. Instead of using absolute values, the *t*-test uses the average changes in variables between the pre-law and post-law periods. This is because the trends in variables are of more importance in a DID set-up, and also because the level of many corporate finance variables would not be meaningful, given that the firm size in treatment and control groups are different. Table 3 reports the *t*-test results. In many characteristics, I find significantly different trends in stock return volatility, board independence, and D&O insurance premium. To consider the possible effect on D&O insurance demand generated by these variables, I control for the three variables in subsequent DID analyses in addition to the total assets, which is naturally different for the two groups by the construction of the experimental settings.

4.2. Main analysis

4.2.1. Differences-in-differences results

Table 4 presents the first set of results in which the absolute amount of insurance coverage is the dependent variable. It contains the estimation results of Eq. (1) for four years of data, running from two years before to two years after the enactment of the law. This means that the two-year averages before (2002 and 2003) and after (2005 and 2006) the law were determined for each variable to establish the change (Δ) from the pre-law to post-law average. I regress the change in D&O insurance coverage on the treatment dummy, which is equal to 1 if the firm has assets of over KRW 2 trillion in 2005. The results in Panel A are based on the data of all firms, including the D&O insurance purchasing and non-purchasing firms. Panel B runs the same regression using only D&O insurance purchasing firms. For both sets of regressions, the first columns give the results for the analysis controlling for firm size by including a change in total assets, and the second columns give the results allowing for more flexibility in firm-size control by including changes in the squared and cubed total assets. The results in the third to fifth columns include controlling variables. Standard errors are clustered by industry. The coefficients appear positive and significant in all regressions.

Specifically, the estimated coefficient of *TreatDummy* in the regression model using all-firm data including asset size[7] (column (2)) is $\beta = 10.392$ ($t = 2.497$), and is statistically significant at the 0.01 level. This implies that firms that were subject to the class action law from 2005 showed an increase of KRW 10.86 billion in D&O insurance coverage between the pre-law and post-law periods compared to the firms that were not affected by the law. The coefficient remains significant even after controlling for changes in insurance premium (column (5), $\beta = 10.302$, $t = 2.121$, $p < 0.01$). The higher coefficient ($\beta = 13.832$) in the regression of the data

[6] The main reason why the insurance coverage of large firms scaled by total assets appeared to decrease from 2007 is that the size of large firms grew rapidly in 2007 and 2008. For example, the size of large firms grew on average by KRW 350 billion per year before 2007 but their average growth was by KRW 1500 billion in 2007 and 2008. One of the reasons could be the relaxation of the regulation in 2007 that used to have ceilings on the total amount of investment that a firm could make in affiliated firms within the same business groups. Previously, affiliated firms could not hold more than 25% of another firm within a business group that was larger than KRW 6 trillion, but this was enhanced to 40% in business groups with total assets over KRW 10 trillion. This eventually allowed for a stronger tendency of cross-holding and circular investment and could have boosted the size of larger firms, which are in many cases part of business groups and are in the treated group in the sample in this study. Additionally, the new government, which implemented radical pro-market policies, was formed in 2008, and firms, especially large ones with superior resources to invest, started to grow faster. Therefore, insurance coverage scaled by total assets may have been affected by firm-size changes in large firms for these two years. At the same time, insurance coverage could not catch up with the firm-size growth promptly because firms already saw a large increase in coverage between 2004 and 2006.

[7] Total assets as a control variable is expressed in trillions whereas D&O coverage as a dependent variable is in billions. This adjustment is done to simply transform the coefficients of total assets into a more readable format.

Table 3
t-Statistics for changes in company characteristics between pre-law and post-law periods.

	Treatment		Control		
	Mean	SD	Mean	SD	Difference (*t*-stat)
Δ Debt Ratio	−0.06	0.13	−0.04	0.13	0.03 (1.47)
Δ Tobin's Q	0.18	0.28	0.15	0.38	−0.03 (−0.55)
Δ Cash Holdings over Total Assets	0.01	0.04	0.01	0.05	−0.00 (−0.46)
Δ Net Income over Total Assets	0.02	0.09	−0.04	0.71	−0.06 (−0.61)
Δ Net Profit over Total Assets	0.01	0.08	−0.04	0.73	−0.05 (−0.52)
Δ CA/TA	0.03	0.07	0.01	0.10	−0.02 (−1.29)
Δ Q Ratio	0.11	0.78	0.13	1.02	0.01(0.09)
Δ ROA	0.02	0.08	−0.00	0.09	−0.02 (−1.27)
Δ ROE	0.00	0.21	−0.01	0.28	−0.01 (−0.33)
Δ Stock Return Volatility	−14.54	12.08	−6.37	17.44	8.18*** (3.35)
Δ Board Size	0.03	2.13	−0.16	1.39	−0.18 (−0.87)
Δ Board Independence	9.35	11.43	2.17	8.51	−7.17*** (−5.72)
Δ Board Ownership	0.20	3.73	0.06	5.34	−0.14 (−0.18)
Δ Ownership Concentration	−1.27	11.22	0.53	10.72	1.80 (1.12)
Δ D&O Premium	0.11	0.73	0.00	0.04	−0.11*** (−3.19)
Observations	56		464		520

This table reports the *t*-test results for the trends of the variables from the pre-law period to the post-law period. The *t*-test is run for the changes in the variables for treat and control group firms between the pre-law and the post-law periods.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

set comprising the insurance purchasing firms only (Panel B column (5), $t = 2.406$, $p < 0.01$) indicates, after the law became effective, on average, the magnitude of increase in D&O coverage is larger among the firms that were already purchasing insurance. This could imply that the results are also driven by the increase in coverage of the purchasing firms, and not by only the non-purchasing firms' transition to purchasing firms, meaning both, extensive margin and intensive margin increase. This effect is somewhat weakened in the following analyses, where I restrict the firm-size effect more strictly by using a scaled version of D&O coverage.

Table 5 presents the regression results using the dependent variable D&O coverage scaled by firm size. The calculation is $\frac{D\&O Coverage}{TotalAssets} \times 100$.[8] This is the main specification of this study, which is expressed in Eq. (3); it is used for all subsequent analyses. As shown in previous studies as well as in this paper, firm size is an important explanatory variable for insurance demand, and the absolute amount of insurance coverage is highly correlated with firm size. To control for the firm-size effect in insurance coverage at a stricter level, I scaled it by firm asset size in 2005 and used it as the dependent variable. Panel A presents the all-firm regression results, and Panel B presents the regression results on the sample of only insurance purchasing firms. The coefficients are positive and significant even in the models controlling for total assets. This implies that insurance coverage as a ratio of total assets varies with firm size. In particular, insurance coverage as a ratio of total assets is found to be lower in larger firms. In other words, this could mean that the standard deviation of insurance coverage is smaller relative to that of total assets. In the all-firm sample regression (Panel A) controlling for total assets (column (2)), the coefficient is $\beta = 0.100$ ($t = 4.55$) and statistically significant, meaning that insurance coverage as a percentage of total assets tended to increase 0.100 more in firms under the influence of the class action law than in firms not affected by the law when the law was introduced. In the sample of insurance purchasing firms (Panel B), the coefficient is significantly positive only in one of the specifications. Although all the coefficients are consistently positive in all models of the sample of insurance purchasing firms, the weakened results may imply that the increase in insurance demand was also driven by the firms that converted from non-purchasing to purchasing firms. The results with stricter control for asset size are overall consistent with those in Table 4 and confirm that firms increase their D&O insurance demand when they experience higher risk in relevant areas. Broadly speaking, the results are in line with previous studies that have showed correlation between litigation risk level proxies and insurance coverage (Core, 1997). However, the main difference is that the result in this paper is drawn from the direct measure of litigation risk rather than proxies and that it updates the previous results to the level of a causal relation.

The data periods adopted in my main analysis are two years before the enactment of the law (2002–2003) and two years after the enactment (2005–2006). By setting short time periods, the analysis captures the effects of the law on insurance at the time of its introduction. However, including a longer term after the institution of the law smooths out any effects from other factors that could have affected the results. As a robustness test, I expand the time periods to three years before the enactment of the law and then to four years. The results from these regressions are confirmed and reported in Table 6.

In addition to the coverage, I explore the effect of the law on D&O insurance premium by replacing the dependent variable with premium. Given that there is an increasing demand for the insurance, the pricing should also adjust itself accordingly, especially when I follow the assumption as in Baker and Griffith (2006, 2007), Boyer and Stern (2012), and Gillan and Panasian (2014, 2015)

[8] D&O Coverage and total assets are in the same scale, and hence, the expression stands for D&O insurance coverage as a percentage of asset size.

Table 4
Estimation Results: ΔD&O Coverage, 2002–2006.

	(1)	(2)	(3)	(4)	(5)
Panel A: All companies					
Treat Dummy	10.131***	10.392***	10.249***	13.477***	10.302***
	(1.795)	(2.497)	(2.517)	(2.111)	(2.121)
Δ Total Assets	4.211**	2.238	1.954	−3.334	2.181
	(1.370)	(3.261)	(3.054)	(2.107)	(3.335)
Δ $TotalAssets^2$		0.145	0.151	0.259**	0.124
		(0.098)	(0.097)	(0.104)	(0.095)
Δ $TotalAssets^3$		−0.002	−0.002	−0.003*	−0.002
		(0.001)	(0.001)	(0.001)	(0.001)
Δ Board Independence			0.052		
			(0.050)		
Δ Stock Return Volatility				−0.021***	
				(0.005)	
Δ D&O Premium					10.505***
					(1.231)
Constant	0.515***	0.613**	0.517	0.743***	0.599**
	(0.114)	(0.224)	(0.296)	(0.088)	(0.228)
Observations	516	516	516	507	516
Adjusted R^2	0.585	0.609	0.611	0.631	0.679
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: D&O insurance purchasing companies					
Treat Dummy	11.206***	14.519***	15.100***	14.376***	13.832***
	(2.340)	(2.482)	(2.119)	(2.569)	(2.406)
Δ Total Assets	3.322**	−4.499*	−4.481*	−4.421	−3.168*
	(1.249)	(2.297)	(2.389)	(2.448)	(1.673)
Δ $TotalAssets^2$		0.288**	0.289**	0.283**	0.246**
		(0.109)	(0.112)	(0.115)	(0.090)
Δ $TotalAssets^3$		−0.003**	−0.003**	−0.003*	−0.003**
		(0.001)	(0.001)	(0.001)	(0.001)
Δ Board Independence			−0.092		
			(0.060)		
Δ Stock Return Volatility				−0.042	
				(0.024)	
Δ D&O Premium					5.259*
					(2.787)
Constant	1.615***	2.277***	2.379***	1.802***	2.230***
	(0.409)	(0.335)	(0.361)	(0.335)	(0.405)
Observations	123	123	123	122	123
Adjusted R^2	0.551	0.625	0.625	0.625	0.647
Firm FE	Yes	Yes	Yes	Yes	Yes

This table provides the estimation results of Eq. (1). The dependent variable is the change in firm *i*'s average D&O insurance coverage between the pre-law and the post-law periods. The pre-period is 2002–2003 and post-period is 2005–2006. Standard errors are in parentheses.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

that the price of insurance reflects the level of risk and the likelihood that an insurance claim is actually made.

The dependent variable represents change in D&O insurance premium from the pre-law period to the post-law period and is scaled by percentage of asset size.[9]

The results are reported in Table 7. The results show that the premium of insurance also increases as a consequence of the introduction of the law. However, the effect is only weakly significant in one of the regressions when data from all companies are used (Panel A) while it shows strong significance in all models in the subset of data of purchasing firms (Panel B). This implies that there is a higher increase in premium when firms that already have D&O insurance try to increase their coverage further compared to when firms start purchasing it for the first time. It shows that the price of insurance is progressively more expensive when firms require an increase of coverage from existing level compared to the price of initial coverage. In other words, the marginal price of insurance becomes higher as the insurance coverage increases. This may reflect the view of an insurance company. When firms decide

[9] Similar to the variables used in the previous regressions, the change in the premium is found using the following equation:

$$\Delta Premium_i = \frac{1}{2}\sum_{t=2005}^{2006} Premium_{it} - \frac{1}{2}\sum_{t=2002}^{2003} Premium_{it}.$$

Table 5
Estimation results: ΔD&O Coverage over Total Assets, 2002–2006.

	(1)	(2)	(3)	(4)	(5)
Panel A: All companies					
Treat Dummy	0.148***	0.100***	0.102***	0.110**	0.098***
	(0.033)	(0.022)	(0.024)	(0.045)	(0.029)
Δ Total Assets	−0.002	0.076**	0.080**	0.031	0.075**
	(0.007)	(0.029)	(0.034)	(0.052)	(0.029)
Δ $TotalAssets^2$		−0.002	−0.002	−0.002	−0.003**
		(0.001)	(0.001)	(0.002)	(0.001)
Δ $TotalAssets^3$		0.000	0.000	0.000	0.000**
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.001		
			(0.002)		
Δ Stock Return Volatility				−0.003	
				(0.002)	
Δ D&O Premium					0.299**
					(0.128)
Constant	0.181***	0.177***	0.178***	0.160***	0.176***
	(0.018)	(0.017)	(0.018)	(0.020)	(0.017)
Observations	516	516	516	507	516
Adjusted R^2	0.003	0.001	−0.001	0.003	0.013
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: D&O insurance purchasing companies					
Treat Dummy	0.090	0.082	0.128*	0.088	0.059
	(0.072)	(0.090)	(0.064)	(0.095)	(0.086)
Δ Total Assets	−0.016**	0.001	0.002	0.002	0.045
	(0.006)	(0.072)	(0.077)	(0.072)	(0.052)
Δ $TotalAssets^2$		−0.001	−0.000	−0.001	−0.002
		(0.002)	(0.003)	(0.002)	(0.002)
Δ $TotalAssets^3$		0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.007		
			(0.006)		
Δ Stock Return Volatility				−0.000	
				(0.002)	
Δ D&O Premium					0.175**
					(0.070)
Constant	0.260***	0.258***	0.266***	0.252***	0.257***
	(0.057)	(0.053)	(0.057)	(0.050)	(0.056)
Observations	123	123	123	122	123
Adjusted R^2	−0.009	−0.026	−0.019	−0.034	−0.013
Firm FE	Yes	Yes	Yes	Yes	Yes

This table provides the estimation results of Eq. (1). The dependent variable is the change in firm *i*'s average D&O insurance coverage scaled by total assets between the pre-law and the post-law periods. The pre-period is 2002-2003 and the post-period is 2005-2006. Standard errors are in parentheses.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

to buy insurance, insurance firms may see the decision as a precautionary action that can come from any firm and apply a standardized price to it. When firms decide to further increase insurance coverage, insurance companies may perceive it as a signal of increasing litigation risk therefore increased probability of insurance claim and decide to charge a progressively higher fee. It is in line with studies in the past on insurance premium that price tends to be higher for those firms with greater exposure to litigation risk (Boyer and Stern, 2012, Gillan and Panasian, 2014, 2015). When the results from coverage and premium are put together, they show that the firms exposed to the law increase their purchase of coverage despite the strong increase in the price of the incremental part of coverage.

4.2.2. Regression discontinuity design

As mentioned before, firm size is the most critical determinant of corporate insurance coverage. To ensure that the results were not driven simply by the heterogeneity of firm size in the two groups of firms, I set an RDD restricting the sample to firms around the asset threshold of KRW 2 trillion. This shows whether the increase in insurance demand is really due to exposure to increased litigation risk rather than to other firm-size-related issues. More importantly, the RDD is expected to address the possibility that the litigation risk shock is not perfectly exogenous, as discussed in Section 3.3. For regression discontinuity, I adopt the main specification using scaled insurance coverage as the independent variable.

To secure a sufficient number of firms so as to return meaningful regression results, I set the narrowest firm-size window to total

Table 6
Estimation results: extended time windows.

	(1)	(2)	(3)	(4)	(5)
Panel A: Time period 2001–2006					
Treat Dummy	0.160***	0.119***	0.120**	0.132**	0.113**
	(0.034)	(0.034)	(0.041)	(0.044)	(0.038)
Δ Total Assets	−0.005	0.060**	0.061*	0.013	0.053**
	(0.007)	(0.026)	(0.032)	(0.037)	(0.019)
Δ $TotalAssets^2$		−0.002	−0.002	−0.001	−0.003***
		(0.001)	(0.001)	(0.001)	(0.001)
Δ $TotalAssets^3$		0.000	0.000	0.000	0.000***
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.000		
			(0.003)		
Δ Stock Return Volatility				−0.003	
				(0.003)	
Δ D&O Premium					0.330**
					(0.141)
Constant	0.200***	0.197***	0.198***	0.172***	0.197***
	(0.015)	(0.014)	(0.016)	(0.022)	(0.014)
Observations	516	516	516	507	516
Adjusted R^2	0.003	0.001	−0.001	0.002	0.014
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: Time period 2000–2006					
Treat Dummy	0.167***	0.136***	0.138**	0.148***	0.129**
	(0.037)	(0.039)	(0.049)	(0.044)	(0.045)
Δ Total Assets	−0.005	0.046	0.048	0.008	0.021
	(0.006)	(0.030)	(0.035)	(0.034)	(0.017)
Δ $TotalAssets^2$		−0.001	−0.001	−0.001	−0.002**
		(0.001)	(0.001)	(0.002)	(0.001)
Δ $TotalAssets^3$		0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.000		
			(0.003)		
Δ Stock Return Volatility				−0.003	
				(0.003)	
Δ D&O Premium					0.376**
					(0.156)
Constant	0.213***	0.210***	0.211***	0.169***	0.210***
	(0.014)	(0.014)	(0.015)	(0.036)	(0.014)
Observations	516	516	516	507	516
Adjusted R^2	0.003	0.001	−0.001	0.002	0.016
Firm FE	Yes	Yes	Yes	Yes	Yes

This table provides the estimation results of Eq. (1). The dependent variable is the change in firm *i*'s average D&O insurance coverage scaled by total assets between the pre-law and the post-law periods. The dependent variable for firm *i*'s pre-period is 2000–2003 and post-period is 2005–2006. Standard errors are in parentheses.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

assets of KRW 2 trillion ± 40%, and perform the same analysis for size windows of KRW 2 trillion ± 50% and KRW 2 trillion ± 60%. I first check whether firms close to the asset size threshold are similar on observable firm characteristics other than treatment and control classification. The variables tested are debt ratio, Tobin's Q, cash holdings, net income, ROE, and stock return volatility, and *t*-tests are run using the absolute 2004 values. Absolute values are adopted because the issue of significantly different firm size in treatment and control groups in the RDD sample no longer exists. The *t*-test results are presented in Table 8, which shows that the differences in observables between the treatment and control groups are not significant in the three asset size windows.

Table 9 presents the results of the analysis based on RDD. Columns (1)–(2) are for the sample comprising firms with total assets of KRW 2 trillion ± 40%, that is, total assets of between KRW 1.2 trillion and KRW 2.8 trillion. For columns (3)–(6), the samples are firms with total assets of KRW 2 trillion ± 50% and KRW 2 trillion ± 60%, respectively. The coefficients of the *TreatDummy* remain positive and significant in all regressions, consistent with the all-sample regression results. In the sample most clustered around the asset threshold, firms with assets of over KRW 2 trillion tend to increase the scaled D&O insurance coverage scaled by assets by 0.426% more than firms that have assets below the cut-off point when the asset size is controlled for (column (2)).[10]

The coefficients in RDD regression are much higher than those in the all-sample regression presented in Table 5, where β is equal

[10] The coefficients remain positive and significant even when the three control variables – board independence, stock return volatility, and D&O insurance premium – are included. An expanded table with additional models including control variables is available upon request.

Table 7
Estimation results: ΔD&O Premium over Total Assets, 2002–2006.

	(1)	(2)	(3)	(4)	(5)
Panel A: All companies					
Treat Dummy	0.001	0.001	0.001	0.002*	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Total Assets	0.000	0.001*	0.000	−0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)
Δ Total Assets2		−0.000	−0.000	0.000	−0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Total Assets3		0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			0.000		
			(0.000)		
Δ Stock Return Volatility				0.000	
				(0.000)	
Δ D&O Coverage over Total Assets					0.010***
					(0.001)
Constant	0.001*	0.001*	0.000	0.001*	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	516	516	516	507	516
Adjusted R^2	−0.001	−0.004	−0.001	−0.006	0.392
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: D&O insurance purchasing companies					
Treat Dummy	0.006***	0.006***	0.006***	0.007***	0.006***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Δ Total Assets	−0.000	−0.001	−0.001	−0.001	−0.001
	(0.000)	(0.003)	(0.003)	(0.003)	(0.003)
Δ Total Assets2		0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Total Assets3		0.000	0.000	−0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			0.000		
			(0.000)		
Δ Stock Return Volatility				0.000*	
				(0.000)	
Δ D&O Coverage over Total Assets					0.007***
					(0.001)
Constant	−0.004***	−0.004***	−0.004***	−0.002*	−0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	123	123	123	122	123
Adjusted R^2	0.038	0.026	0.021	0.094	0.105
Firm FE	Yes	Yes	Yes	Yes	Yes

This table provides the estimation results of Eq. (1) by replacing the dependent variable to the change in firm *i*'s average D&O insurance premium scaled by total assets between the pre-law and the post-law periods. The pre-period is 2002–2003 and the post-period is 2005–2006. Standard errors are in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

to 0.100. Further, a comparison of the coefficients from three different samples of firms shows that the difference in insurance demand between firms with assets over KRW 2 trillion and those with assets below KRW 2 trillion is greatest in the sample of firms with asset size closest to the threshold, that is, firms within the asset size window of KRW 2 trillion ± 40%. The fact that the difference appears to be largest in the sample most clustered around the asset threshold implies that the causal relation in econometrics is not simply driven by firm size, but rather that the change in law led to the increase in insurance demand.

4.2.3. Second event in 2007

In this section, I run the main specification regression using 2007 as the event year. At the beginning of 2007, smaller firms previously classified as the "*Control*" group also became exposed to the risk of shareholder class action following the exposure of larger firms in 2005 with two years' gap. To test whether a similar causal effect can be found in the control firms, I define the pre-law period as 2004–2005 and post-law period as 2007–2008 and convert *TreatDummy* to 1 if the firms are with assets below KRW 2 trillion as of 2005 (1 for firms previously classified as "*Control*"). The results are presented in Table 10.

The *TreatDummy* coefficient, which is now 1 for firms with assets below KRW 2 trillion, appears positive and significant for most specifications in both the all-company and purchasing firms only samples, supporting the main findings in the first event in 2005. This confirms for the second time that firms react with increased hedging to the exposure to litigation risk. These results also show that larger firms already exposed for two years stabilized with the level of insurance coverage (no lagged effect) whereas smaller

Table 8
t-Statistics: RDD samples.

	Treatment		Control		
	Mean	SD.	Mean	SD	Difference (*t*-stat)
Panel A: Assets between 1.2 and 2.8 tn KRW					
Debt Ratio	0.55	0.13	0.53	0.18	−0.02 (−0.43)
Tobin's Q	0.91	0.23	0.83	0.42	−0.08 (−0.63)
Cash Holdings over Total Assets	0.03	0.03	0.03	0.05	0.01 (0.37)
Net Income over Total Assets	0.05	0.07	0.04	0.04	−0.01 (−0.82)
Net Profit or Loss over Total Assets	0.06	0.08	0.04	0.05	−0.02 (−0.84)
CA/TA	0.31	0.17	0.32	0.14	0.01 (0.23)
Q Ratio	0.59	0.34	1.08	1.68	0.49 (1.00)
ROA	0.05	0.07	0.04	0.04	−0.01 (−0.82)
ROE	0.11	0.14	0.08	0.07	−0.04 (−1.12)
Stock Return Volatility	48.86	9.19	50.66	10.71	1.80 (0.52)
Observations	13		29		42
Panel B: Assets between 1.0 and 3.0 tn KRW					
Debt Ratio	0.54	0.13	0.54	0.19	−0.01 (−0.12)
Tobin's Q	0.89	0.23	0.85	0.39	−0.04 (−0.35)
Cash Holdings over Total Assets	0.02	0.03	0.03	0.05	0.01 (0.69)
Net Income over Total Assets	0.06	0.07	0.04	0.05	−0.01 (−0.62)
Net Profit or Loss over Total Assets	0.06	0.07	0.05	0.05	−0.01 (−0.56)
CA/TA	0.28	0.16	0.32	0.14	0.03 (0.63)
Q Ratio	0.58	0.34	1.04	1.49	0.46 (1.13)
ROA	0.06	0.07	0.04	0.05	−0.01 (−0.62)
ROE	0.12	0.13	0.10	0.09	−0.02 (−0.63)
Stock Return Volatility	50.05	10.26	51.50	13.75	1.45 (0.37)
Observations	15		37		52
Panel C: Assets between 0.8 and 3.2 tn KRW					
Debt Ratio	0.67	0.54	0.53	0.20	−0.15 (−1.61)
Tobin's Q	0.99	0.50	0.82	0.37	−0.17 (−1.49)
Cash Holdings over Total Assets	0.03	0.05	0.04	0.06	
Net Income over Total Assets	−0.03	0.35	0.04	0.07	0.00 (0.22)
Net Profit or Loss over Total Assets	−0.03	0.36	0.04	0.08	0.07 (1.30)
CA/TA	0.28	0.16	0.33	0.16	0.05 (1.05)
Q Ratio	0.55	0.33	1.03	1.32	0.49 (1.45)
ROA	0.02	0.14	0.04	0.07	0.02 (0.60)
ROE	0.16	0.21	0.06	0.22	−8.44 (−1.20)
Stock Return Volatility	59.97	38.88	51.53	16.31	
Observations	17		48		65

This table reports the summary statistics and the *t*-test results for characteristics of RDD samples. The data in this table are from the year, 2004. The samples in Panel A are companies with assets between 1.2 and 2.8 trillion Korean Won, and the samples in subsequent panels are companies with assets between 1.0 and 3.0 trillion Korean Won and companies with assets between 0.8 and 3.2 trillion Korean Won. *t*-Statistics are in parentheses.

firms react at the time of exposure although they knew about the exposure to law well in advance (no anticipation effect). However, in the analysis of the second event, when the change in insurance premium is included as the control variable, the results are not significant. Especially in the all-sample regression, only the coefficient for the change in insurance premium shows significance. This implies that the changes in insurance coverage levels led to changes in premiums. One possible explanation is that while insurance companies were somewhat slow in adjusting their prices to demand at the first event, this was not the case for the second event and they adjusted the premiums almost simultaneously to the increase in coverage demand.

4.3. Heterogeneities in insurance demand

This section explores the heterogeneities in companies' demand for insurance using split sample regressions. I test whether the firms' demand for D&O insurance varies according to the risk exposure level of the different types of companies. The dimensions explored are industry membership and agency conflicts proxied by the presence of hired CEOs or owner-CEOs. One concern in split sample regression is that, if samples split results in significant differences in firm characteristics, it is hard to interpret that the regression results are due to the split criteria. Hence, before the regressions, I run *t*-tests for split samples to make sure the firm characteristics are not significantly different in the split samples. Table 11 reports the *t*-test results for samples that are split based on industry (Panel A) and management-shareholder relationship type (Panel B). The results confirm that, broadly speaking, there is no significant difference between firm characteristics of the two sets of split samples.

First, I examine whether insurance demand differs according to the type of industry a firm belongs to. Industry membership is

Table 9
RDD: ΔD&O Coverage over Total Assets.

	Assets: 1.2–2.8 tn		Assets: 1.0–3.0 tn		Assets: 0.8–3.2 tn	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat Dummy	0.382***	0.426***	0.262***	0.307***	0.224***	0.255***
	(0.055)	(0.028)	(0.066)	(0.055)	(0.053)	(0.048)
Δ Total Assets	0.073	−1.239	0.044	−1.002	0.011	−0.580
	(0.091)	(0.955)	(0.062)	(0.650)	(0.058)	(0.836)
Δ $TotalAssets^2$		0.755		0.642		0.382
		(0.497)		(0.348)		(0.458)
Δ $TotalAssets^3$		−0.130		−0.113*		−0.070
		(0.078)		(0.053)		(0.072)
Constant	0.162***	0.148***	0.220***	0.203***	0.264***	0.256***
	(0.024)	(0.028)	(0.044)	(0.041)	(0.044)	(0.041)
Observations	42	42	52	52	65	65
Adjusted R^2	0.280	0.274	0.098	0.112	0.026	0.009
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

This table presents the results from the regression discontinuity design for different bands of asset sizes. The regressions in the first two columns are run using firms with asset sizes between 1.2 and 2.8 trillion Korean Won and then the asset size bands were extended to between 1 and 3 trillion Korean Won and between 0.8 and 3.2 trillion Korean Won in the next columns. Standard errors are in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

used widely as a predictor of litigation risk and, in all D&O insurance studies that adopt empirical methods, it is considered to be one of the critical control variables.[11] The classification of high litigation risk industry was first provided by Francis et al. (1994), who suggested that firms in financial, healthcare, services, and technology industries faced higher litigation risk relative to firms in other industries because they were subject to higher incidence of litigation between 1988 and 1992. Kim and Skinner (2012) additionally showed that for more than a decade (1996–2009), firms in these industries were consistently exposed to higher litigation risk and that such classification has been useful until recent years. Gillan and Panasian (2014) also report high numbers of litigations for a similar list of industries. Therefore, following the definition of Francis et al. (1994), I consider firms in the healthcare, services, and technology industries as having high litigation risk.[12] No financial firms are included in the data and hence they are not considered here. From the classification of industries, the sample can be divided into two groups. Thus, I have 101 firms in the high litigation risk industries and 419 firms in other industries.

I run the main specification regressions separately for high and low litigation risk industry firms. The results are presented in Table 12. Panel A is for the high litigation risk industry sample. The coefficients of interest in this panel are much larger than those for low litigation risk industry firms, as shown in Panel B. Although insurance demand is also increasing significantly in the low risk industry, the results show that it goes up much more strongly when the firms are operating in an industry with potentially higher exposure to litigation.

Second, I perform a split regression analysis in a similar manner for samples with different types of shareholder (owner) and management relationship, that is, owner-CEOs and hired CEOs. When management and ownership are separated, firms are likely to suffer more severe agency conflicts. Managers may have incentives to exert less effort than optimal, and owners (shareholders) may suffer from the cost of monitoring. The information asymmetry that may arise between the management and shareholders is likely to result in ex post disagreements on important decisions regarding company operation and hence, may increase the likelihood of legal disputes between shareholders and the management. In contrast, if a firm is managed by its shareholders, the interests between the management and shareholders are better aligned, information asymmetry issues are alleviated, and the risk of litigation could be lower. According to this argument, firms with owner-CEOs are less likely to feel the need for D&O insurance, and therefore demand less. However, there can be the opposite argument that D&O insurance induces a moral hazard and managerial opportunism. Empirical studies in the past have presented mixed results. Core (1997) show that firms with greater inside ownership are less likely to purchase the insurance given that they suffer from lower agency conflicts. On the other hand, Gillan and Panasian (2014) present a different empirical finding that firms with D&O insurance coverage are more likely to be sued and that the likelihood of litigation increases with increased coverage. Hence, the question is still not clearly answered and further empirical work can be done regarding this question. All the papers mentioned in this response are discussed and cited in the updated manuscript. Hence, the question still has room for further empirical analysis.

To test this, I divide the sample into two groups and test the main hypothesis for each group: firms managed by a CEO who is also

[11] For some examples, see Boyer and Stern, 2014, Core (1997), and Gillan and Panasian (2014, 2015).
[12] In a more detailed industry classification, they are biotech firms, computer firms, electronics firms, and retail firms.

Table 10
Second event in 2007.

	(1)	(2)	(3)	(4)	(5)
Panel A: All companies					
Treat Dummy (Below 2tn)	0.242**	0.282**	0.274**	0.256*	−0.012
	(0.096)	(0.106)	(0.107)	(0.118)	(0.074)
Δ Total Assets	0.008	0.082	0.073	0.087*	−0.038
	(0.013)	(0.052)	(0.056)	(0.043)	(0.039)
Δ $TotalAssets^2$		−0.003	−0.002	−0.003	0.002
		(0.002)	(0.002)	(0.002)	(0.002)
Δ $TotalAssets^3$		0.000	0.000	0.000	−0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			0.002		
			(0.004)		
Δ Stock Return Volatility				−0.001	
				(0.004)	
Δ D&O Premium					1.526***
					(0.345)
Constant	0.191***	0.142*	0.145*	0.147	0.450***
	(0.046)	(0.063)	(0.067)	(0.106)	(0.088)
Observations	520	520	520	513	520
Adjusted R^2	−0.002	−0.006	−0.007	−0.008	0.006
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: D&O insurance purchasing companies					
Treat Dummy (Below 2tn)	0.042	0.091**	0.121*	0.104**	0.012
	(0.035)	(0.037)	(0.054)	(0.044)	(0.026)
Δ Total Assets	0.008	0.114**	0.131***	0.094**	0.080**
	(0.012)	(0.039)	(0.036)	(0.036)	(0.027)
Δ $TotalAssets^2$		−0.004**	−0.004**	−0.003**	−0.003**
		(0.002)	(0.002)	(0.001)	(0.001)
Δ $TotalAssets^3$		0.000*	0.000**	0.000*	0.000*
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.005		
			(0.006)		
Δ Stock Return Volatility				0.007	
				(0.006)	
Δ D&O Premium					0.383
					(0.213)
Constant	0.191**	0.119*	0.110*	0.040	0.211**
	(0.060)	(0.054)	(0.052)	(0.095)	(0.079)
Observations	157	157	157	155	157
Adjusted R^2	−0.012	−0.008	−0.008	0.004	0.003
Firm FE	Yes	Yes	Yes	Yes	Yes

This table provides estimation results of Eq. (1) using the time period when the implementation of the law was extended to all public firms. "Treated firms" in previous analyses (firms with assets over KRW 2 trillion) had been already exposed to the law for two years by then, and firms that were previously termed "control firms" that were with assets below the threshold became newly exposed to the law. The analysis in this table tests the insurance purchase reaction of the newly exposed ones by converting the classification of treat to control and control to treat. The dependent variable is the change in firm *i*'s average D&O insurance coverage scaled by total assets. TreatDummy is 1 for those firms that were newly exposed to the law, hence those with total assets below KRW 2 trillion as of 2005. Therefore, the positive coefficients indicate that firms that were previously control firms in the previous period increased their insurance demand more strongly when compared to larger firms when they were also exposed to the law. The pre-period in this analysis is 2004–2005 and the post-period is 2007–2008. Standard errors are in parentheses.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

one of their three largest shareholders, and firms managed by hired CEOs. I have 237 firms in the owner-CEO group and 283 firms in the hired-CEO group.[13]

The split regression results in Table 13 show that only the firms that are likely to suffer from agency conflicts between management and shareholders react to the exogenous shock on litigation risk by increasing their insurance coverage (Panel B), and that firms managed by their largest shareholder do not react (Panel A). This means that corporate governance-related issues play a role in

[13] Given that the owner-CEO is defined as a CEO who is also one of the largest shareholders in the firm, there can be an alternative hypothesis. When a large shareholder occupies management power as well, her managerial decisions may help large shareholders expropriate the minority shareholders' value. If the interest conflicts between the majority and minority shareholders overweigh the agency conflicts between large shareholders and minority shareholders, firms with owner-CEOs are likely to experience higher litigation risk. Especially with the introduction of the law making it easier for minority shareholders to raise litigation, the increase in hedging demand should be more pronounced in firms managed by owner-CEOs. However, the results do not support the alternative hypothesis.

Table 11
Split samples: *t*-Statistics for changes in company characteristics between pre-law and post-law periods.

	Panel A: Industry type				
	High risk industry		Low risk industry		
	Mean	SD	Mean	SD	Difference (*t*-stat)
Δ Debt Ratio	−0.04	0.13	−0.04	0.13	−0.00 (−0.16)
Δ Tobin's Q	0.18	0.42	0.15	0.35	−0.03 (−0.78)
Δ Cash Holdings over Total Assets	0.00	0.05	0.01	0.05	0.01 (1.13)
Δ Net Income over Total Assets	−0.01	0.14	−0.04	0.75	−0.03 (−0.37)
Δ ROE	0.00	0.32	−0.01	0.26	−0.01 (−0.41)
Δ Stock Return Volatility	−6.30	16.95	−7.46	17.18	−1.16 (−0.60)
Δ Board Size	−0.06	1.16	−0.15	1.55	−0.09 (−0.56)
Δ Board Independence	3.38	10.69	2.84	8.73	−0.54 (−0.53)
Δ Board Ownership	−0.47	8.91	0.21	3.83	0.68 (1.16)
Δ Ownership Concentration	0.62	8.63	0.26	11.21	−0.37 (−0.28)
Δ D&O Premium	0.04	0.49	0.01	0.12	−0.03 (−1.27)
Δ ROA	0.00	0.10	0.00	0.09	0.00 (0.14)
Δ Debt-to-Equity	−0.48	3.16	−0.94	10.24	−0.45 (−0.44)
Δ Q Ratio	0.14	1.28	0.12	0.92	−0.02 (−0.14)
Δ Net Profit over Total Assetes	−0.01	0.14	−0.04	0.77	−0.03 (−0.38)
Δ FCF over Total Assets	−0.00	0.09	−0.01	0.10	−0.01(−1.16)
Δ CA/TA	0.00	0.10	0.02	0.09	0.02 (1.60)
Observations	101		419		520
	Panel B: Management-shareholder relation type				
	Owner-CEO		Hired-CEO		
	Mean	SD	Mean	SD	Difference (*t*-stat)
Δ Debt Ratio	−0.03	0.12	−0.05	0.13	−0.02 (−1.41)
Δ Tobin's Q	0.12	0.33	0.18	0.40	0.06 (1.89)
Δ Cash Holdings over Total Assets	0.00	0.05	0.01	0.06	0.01 (1.29)
Δ Net Income over Total Assets	−0.07	0.98	−0.00	0.17	0.06 (1.09)
Δ ROE	−0.01	0.24	−0.01	0.30	0.00 (0.16)
Δ Stock Return Volatility	−6.24	15.21	−8.09	18.60	−1.86 (−1.22)
Δ Board Size	−0.20	1.56	−0.08	1.41	0.11 (0.86)
Δ Board Independence	3.61	9.51	2.39	8.78	−1.22 (−1.52)
Δ Board Ownership	0.41	5.39	−0.21	5.00	−0.62 (−1.34)
Δ Ownership Concentration	−0.34	9.24	0.96	12.06	1.29 (1.27)
Δ D&O Premium	0.01	0.18	0.01	0.29	−0.00 (−0.01)
Δ ROA	−0.00	0.08	0.00	0.10	0.01 (0.87)
Δ Debt-to-Equity	−0.22	1.84	−1.37	12.47	−1.16 (−1.42)
Δ Q Ratio	0.11	0.98	0.14	1.02	0.03 (0.32)
Δ Net Profit over Total Assetes	−0.07	1.00	−0.00	0.17	0.07 (1.07)
Δ FCF over Total Assets	−0.00	0.10	−0.02	0.09	−0.01 (−1.40)
Δ CA/TA	0.01	0.08	0.02	0.10	0.01 (1.46)
Observations	237		283		524

This table reports the t-test results for the trends of the variables from the pre-law period to the post-law period. The t-test is run for the changes in the variables for split samples: in Panel A, the sample is split between high litigation risk industry and low litigation risk industry firms and in Panel B, the sample is split between firms that are run by owner-CEOs and hired CEOs.

corporate demand for hedging, as predicted in previous studies (Thakor, 1982; Mayers and Smith, 1982; and Grace and Rebello, 1993) and as an empirical finding it is more in line with Core's (1997) finding that lower information asymmetry leads to lower demand for D&O insurance.[14]

5. Conclusion

In this paper, I explore whether companies react to changing risk environments by adjusting their demand for hedging. Taking advantage of the exogenous litigation risk shock to which only one group of firms are exposed, I empirically tested the causal relation between litigation risk and D&O insurance demand in a DID analysis.

A preliminary analysis showed that before the law was introduced, there was a fairly clear parallel trend in insurance demand between two groups of firms, one affected by the shareholder class action law, and the other not affected. In the DID analysis, I find

[14] I also test the hypotheses by including interaction terms between industry and treatment and owner-CEO and treatment using all-sample. The results are consistent and significant in the models with interaction terms, as well. The tables are available upon request.

Table 12
Split regressions: firms in high vs. low litigation risk industries.

	(1)	(2)	(3)	(4)	(5)
Panel A: High litigation risk industry					
Treat Dummy	0.225	0.246**	0.253**	0.562***	0.424***
	(0.172)	(0.050)	(0.053)	(0.066)	(0.055)
Δ Total Assets	−0.017	−0.210	−0.252	−0.302	−0.561
	(0.008)	(0.344)	(0.377)	(0.213)	(0.241)
Δ $TotalAssets^2$		0.013	0.014	0.004	0.034*
		(0.022)	(0.022)	(0.013)	(0.014)
Δ $TotalAssets^3$		−0.000	−0.000	−0.000	−0.000*
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			0.004		
			(0.004)		
Δ Stock Return Volatility				−0.001	
				(0.001)	
Δ D&O Premium					0.302*
					(0.098)
Constant	0.192***	0.197***	0.191***	0.201***	0.203***
	(0.010)	(0.019)	(0.014)	(0.021)	(0.014)
Observations	101	101	101	97	101
Adjusted R^2	−0.016	−0.035	−0.043	−0.039	−0.009
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: Low litigation risk industry					
Treat Dummy	0.141***	0.178***	0.188***	0.163***	0.152**
	(0.035)	(0.041)	(0.044)	(0.050)	(0.052)
Δ Total Assets	−0.056***	−0.158**	−0.151**	−0.155**	−0.207***
	(0.013)	(0.057)	(0.057)	(0.054)	(0.053)
Δ $TotalAssets^2$		0.004*	0.004	0.004*	0.006***
		(0.002)	(0.002)	(0.002)	(0.002)
Δ $TotalAssets^3$		−0.000*	−0.000	−0.000*	−0.000***
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.002		
			(0.002)		
Δ Stock Return Volatility				−0.003	
				(0.002)	
Δ D&O Premium					0.550***
					(0.069)
Constant	0.146***	0.152***	0.157***	0.123***	0.156***
	(0.031)	(0.033)	(0.030)	(0.022)	(0.033)
Observations	419	419	419	411	419
Adjusted R^2	0.002	−0.000	−0.002	0.010	0.012
Firm FE	Yes	Yes	Yes	Yes	Yes

This table reports the results of split regressions on firms in high and low litigation risk industries. Regressions in Panel A are performed using the sample of firms in high litigation risk industry while those in Panel B are for sample of firms in low litigation risk industry. Standard errors are in parentheses.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

that companies subject to the law increase their D&O insurance demand more than the unaffected firms. In the additional DID analysis of the law's effect on insurance premium, I also show that the insurance premium increases and that it increases more strongly in the group of firms that already had insurance. Taken together with the increase in coverage, it shows that companies increase D&O insurance coverage even with increasing price for incremental part of insurance when they experience increased litigation risk. I also show that the results are robust with different specifications of the dependent variable, D&O insurance coverage, and in additional tests which are the RDD and the second event tests. Considering the robust results, I conclude that corporate insurance demand arises from the risks that firms face in the business environment. This is a reflection of the fact that in risky situations, firms use insurance to protect themselves and thereby their shareholder value, and that firms adjust their insurance demand to changing the environment flexibly in a timely manner.

By showing that being subject to the class action law, that is, exposed to higher litigation risks, clearly explains insurance demand, I show that risk is an important driver of corporate insurance demand, which is this paper's prime contribution. Given that the structure of D&O insurance contracts and their wide use are fairly standard in most developed financial markets, the results may extend to the listed corporations in liquid and competitive financial markets in other parts of the world.

After confirming the main findings, I extend the DID analysis to explore the cross-sectional heterogeneities in D&O insurance demand in two aspects: industry, and shareholder-management relationship. Under industry, I classify the firms with a high level of litigation risk, and under shareholder-management relationship, I identify the firms that suffer from relatively high agency costs. I

Table 13
Split regressions: firms with owner-CEOs vs. hired-CEO firms.

	(1)	(2)	(3)	(4)	(5)
Panel A: Owner-CEO firms					
Treat Dummy	0.084	0.052	0.060	0.086	0.055
	(0.072)	(0.086)	(0.082)	(0.080)	(0.053)
Δ Total Assets	0.040	0.132*	0.144**	0.129	0.151*
	(0.032)	(0.066)	(0.061)	(0.085)	(0.071)
Δ $TotalAssets^2$		−0.005	−0.005	−0.015**	−0.019**
		(0.004)	(0.004)	(0.006)	(0.007)
Δ $TotalAssets^3$		0.000	0.000	0.000**	0.001**
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			−0.003**		
			(0.001)		
Δ Stock Return Volatility				−0.005**	
				(0.002)	
Δ D&O Premium					0.985*
					(0.524)
Constant	0.164***	0.159***	0.166***	0.134***	0.158***
	(0.029)	(0.029)	(0.030)	(0.021)	(0.027)
Observations	237	237	237	234	234
Adjusted R^2	0.004	−0.001	−0.002	0.014	0.023
Firm FE	Yes	Yes	Yes	Yes	Yes
Panel B: Hired-CEO firms					
Treat Dummy	0.168***	0.136**	0.130*	0.141*	0.105
	(0.051)	(0.052)	(0.064)	(0.067)	(0.079)
Δ Total Assets	−0.012*	0.053	0.053	0.048	0.161***
	(0.007)	(0.037)	(0.036)	(0.039)	(0.038)
Δ $TotalAssets^2$		−0.002	−0.002	−0.002	−0.005***
		(0.002)	(0.002)	(0.002)	(0.001)
Δ $TotalAssets^3$		0.000	0.000	0.000	0.000***
		(0.000)	(0.000)	(0.000)	(0.000)
Δ Board Independence			0.002		
			(0.004)		
Δ Stock Return Volatility				−0.002	
				(0.002)	
Δ D&O Premium					0.294**
					(0.105)
Constant	0.199***	0.196***	0.193***	0.170***	0.176***
	(0.039)	(0.039)	(0.033)	(0.029)	(0.041)
Observations	283	283	283	274	274
Adjusted R^2	−0.003	−0.009	−0.012	−0.010	0.001
Firm FE	Yes	Yes	Yes	Yes	Yes

This table reports the results of split regressions on shareholder and management relationship. Regressions in Panel A are performed using the sample of owner-CEO firms and those in Panel B are using the sample of hired-CEO firms. Standard errors are in parentheses.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

test whether the corporate demand for insurance varies with the two aspects in split sample regressions. I find that firms in high litigation risk industries react more strongly to an exogenous change in litigation risk, while those with lower agency costs (owner-CEO firms) do not react as much as the firms with high agency costs do. This provides causal evidence to supplement discussions in the past that were aimed at identifying the channels leading firms to higher demand for hedging.

This study makes two major contributions to the literature. First, it provides empirical evidence of a causal relation between firm risk and corporate insurance demand and proves that risk works as a main driver of corporate insurance demand. Second, by analyzing the firm characteristics using the empirical set-up, the study identifies some of the possible channels that drive corporate hedging demand, often considered as correlation in previous studies.

It is worth mentioning that the quasi-experimental set-up in this study also provides a good ground for further studies on D&O insurance and corporate litigation risk. One possible field of study to explore further is the interaction between corporate governance and the role of D&O insurance and litigation risk. The topic was briefly visited in this study and showed that firms react differently with their D&O insurance demand depending on their CEO types. A further study can be designed to explore corporate governance-related issues with greater depth. For example, by additionally observing the changes in board structure after the litigation risk shock, one can identify complementarity or substitutability between D&O insurance and other governance variables. Another possible field of study would be the interaction between litigation risk and corporate finance structure. One can empirically test how the purchase of D&O insurance interacts with corporate finance variables that are known to be sensitive to litigation risk, such as cash holdings.

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