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Internal Governance and Litigation Risk

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INTERNAL GOVERNANCE AND LITIGATION RISK

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Mohammad Hashemi Joo

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To: Dean Joanne Li
College of Business

This dissertation, written by Mohammad Hashemi Joo, and entitled Internal Governance and Litigation Risk, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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DEDICATION

I dedicate this dissertation to my parents. Without their unwavering support and unconditional love, the completion of this work would not have been possible.

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ABSTRACT OF THE DISSERTATION

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This dissertation is comprised of three chapters that focus on the topics related to internal governance and litigation risk.

The first essay investigates the effect of board independence on security litigation risk. Based on the premise of the agency theory, our findings indicate that board independence has a negative impact on securities litigation risk. The effectiveness of this impact is also analyzed in light of the firm's complexity and monitoring cost. The results show that board independence effectiveness is negatively related to the firm's monitoring cost but is positively influenced by the firm's complexity. Our results challenge the notions of 'one-size-fits-all governance remedies' to reduce litigation risk and are robust across several alternatives and nested variations, including considerations of endogeneity and heterogeneity.

The second essay examines the effect of gender diversity in boardroom on security litigation risk. Using panel data analyses from 1998 to 2017, we find that securities litigation risk is inversely related to the fraction of female independent directors on a company board. Additionally, the effectiveness of female independent directors in

reducing litigation risk is negatively related to the firm's monitoring cost and positively related to the firm's complexity. We further investigate the channels through which female independent directors may reduce litigation risk, and attribute it to improvement in board participation and accounting conservatism.

The third essay studies the effect of board independence on corporate workplace safety. Using a sample of S&P 1500 firms' establishments that participated in the Survey of Occupational Injuries and Illnesses by Occupational Safety and Health Administration, we find that board independence has a significant negative effect on workplace injury/illness rates. Further, results of the two-stage instrumental approach show that these findings are robust to endogeneity consideration. Our study contributes to literature on corporate governance effect on corporate social responsibility (CSR). Enhancing the Workplace safety is considered as one of the most important CSR activities since it substantially contributes to social welfare. We provide the empirical supports for the conflict resolution hypothesis which argues that more effective governance increases firms' CSR activities.

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CHAPTER 1: LITIGATION RISK IN LIGHT OF BOARD INDEPENDENCE, FIRM COMPLEXITY, AND MONITORING COSTS

1.1 Introduction

Nearly all firms, particularly the U.S. firms, run the risk of being targeted in a litigation lawsuit. During 1998 to 2017, there have been a whopping 19,555 securities lawsuit cases against the U.S. publicly traded firms.[1] The direct and indirect costs associated with these lawsuit cases prompt the need to take litigation risk seriously and manage it, if possible, effectively. The direct costs include the settlement expenses and attorney's fees. The indirect costs include increases in the implicit and explicit costs of contracts, damage to the firm's reputation, and negative effect on the firm's relations with suppliers and customers (Engelmann and Cornell, 1988). Considering all settled securities lawsuit cases against the U.S. publicly traded firms, the average settlement expense is around 223 million dollars. This is considerable and high enough to affect the firms' financial and investment policies.

Although the U.S. firms buy insurance coverage to protect themselves against the direct costs of possible litigations against them, there are limits in such protection plans and in more than 50 percent of the cases, firms that agree to settle have to pay some out-of-pocket settlement expenses (Arena and Julio, 2015). In addition, insurance coverage does not cover indirect costs associated with lawsuit cases. Some prior studies have shown that litigation risk and its related expenses might negatively affect the liquidity, investment

[1] Based on Audit Analytics Litigation Database.

policy, external financing policy, credit worthiness, and payout policy of firms (e.g., Autore et al., 2014; Arena and Julio, 2015; Arena, 2018; and Arena and Julio, 2016).

Over time, firms have gradually learned that an effective venue that reduces litigation risk and thereby its associated expenses is to establish a strong internal governance structure. Previous studies show that weak internal governance reduces the creditability of a firm's financial statements and encourages misconducts, including earning manipulations (see, for instance, Dechow, Sloan and Sweeny 1996; Beasley 1996; and Johnson, Kasznik and Nelson, 2000). On the other hand, it is argued that a strong governance structure is expected to reduce the potential for litigations.

On the theoretical side, we rely on the agency theory (see, among others, Jensen and Meckling, 1976). Based on this theory, the separation of ownership and management team (MT) leads to conflicts of interest between management and shareholders. Aligning the MT's interests with shareholders' is a significant step to improve the firm's governance and thereby its performance. A venue to achieve this alignment is to appoint *non-executive* directors who are *independent* from management control and do *not* have any affiliation with the firm (henceforth independent directors). The independent directors value their personal reputations and are keen on their own performance (Fama, 1980; Fama and Jensen, 1983). As such, they end up representing the shareholders' interests better than the insider directors (Carter et al, 2003). This feature arises because the future careers of the independent directors in the governance market are heavily dictated by their performance in their directorship positions. Simply stated, the independent directors have more incentives to monitor management compared with the insider directors whose promotions are decided within the firm.

One of the determinants of internal governance quality is the proportion of independent directors among the board directors. Some researchers suggest that higher proportion of independent directors increases the monitoring power of the board and decreases a firm's information asymmetry (see, for instance, among relatively recent contributions, Petra, 2006; Ferreira et al, 2011; Armstrong et al, 2014; and Chen et al, 2015). Other researchers, however, argue that social ties of independent directors with CEOs and the role of CEOs in appointing them reduce independent directors' monitoring power, thus rendering little to no effect on litigation risk (Nguyen, 2012; Francis et al, 2012; Cohen et al, 2012; Fracassi and Tate, 2012; and Kim and Lu, 2017).

Although the effect of independent directors on a firm's transparency and performance has been extensively studied, studies on their impact on securities litigations are relatively sparse and lack consensus in findings. For instance, Tally (2009) argues that most governance indicia including board independence have negligible predictive value, both statistically and economically. However, this study has some serious limitations since the author uses a small sample that covers only about five years (2001-2005) of data. Malm and Mobbs (2016) find that board independence does not affect securities litigation risk, but they find mixed results for non-securities litigations. This study also has some limitations. It uses Poisson regression model that assumes, by construct, the number of lawsuits against firms has a poison distribution wherein its conditional mean is equal to its conditional variance. This is an unwarranted assumption since standard empirics on the analysis of mean and variance indicate that the second moment is larger than the first. We do observe this fact in our data, i.e., the conditional variance of number of lawsuits is much higher than its conditional mean.

In addition to studying the effect of board independence on a firm's securities litigation risk, we also investigate how monitoring cost and firm complexity might change this effect. Our coverage includes the S&P1500 firms over the period of 1998 to 2017. We contribute to previous literature in at least three regards.

First, we identify a causal relation between board independence and securities litigation while addressing endogeneity thoroughly in specification and econometric estimation. Board independence is determined endogenously since it is possible that firms with higher *ex-ante* litigation risk would hire independent directors to improve their future position against potential litigation risk. Also, it is possible that independent directors are more inclined to join firms with lower litigation risk. We examine and incorporate endogeneity by considering a three-front analyses: conditional fixed-effects logit model, linear probability model (LPM) with firm fixed effects, and two-stage instrumental variables (IV). We pay special attention to endogeneity and thereby to the choice of the instrumental variables. We run several tests to confirm that the requirements of 'relevance' and 'exclusion' conditions for the selected IV's are satisfied (Nash and Patel, 2019). We use the proportion of independent directors in the counties of firms' headquarters and the proportion of independent directors in the firms' industry (SIC 2-digit) as instruments for board independence. Our results show that board independence negatively affects securities litigation risk.

Second, monitoring cost is recognized as a variable in the evaluation of firm performance. Therefore, we examine how a firm's monitoring cost changes the effectiveness of independent directors in reducing securities litigation risk. We proxy the monitoring cost by the standard deviation of returns and R&D expenditures. Our findings indicate that the effectiveness of board independence in reducing litigation risk is negatively related to the monitoring cost, i.e., the higher the monitoring cost, the higher the noisiness and unpredictability of a firm's environment, and thereby the lower the effect of board independence. Additionally, we provide empirical evidence that uncertainty in a firm's operating environment decreases independent directors' effectiveness in reducing the litigation risk.

Finally, we investigate how a firm's complexity affects the effectiveness of board independence in reducing securities litigation risk. This arises because there is a hierarchy of differences among firms. In particular, effectiveness of board independence for firms of all sizes, age groups, and varied geographic locations is not necessarily the same. Our results indicate that the effectiveness of independent directors in reducing litigation risk is higher in firms with a higher level of complexity. We verify that firms with more complexity are prone to more potential for litigation risks and the independent directors happen to be more effective in reducing them. We proxy firm complexity by size, age, and operations overseas.

Our empirical findings have important implications for policy makers and regulators. In general, our robust statistical results indicate that 'one-size-fits-all governance remedies' to reduce litigation risk is suboptimal. Internal governance requirements do not need to be necessarily the same for all types of firms. To optimize the outcome, we recommend establishing a set of firm-specific internal governance requirements that are based on the firms' operational environment and complexity.

As to the remainder of this paper, section 1.2 presents hypotheses development. Section 1.3 discusses the data and methodology. Section 1.4 provides summary statistics on the variables used. Section 1.5 presents the empirical results. Section 1.6 concludes.

1.2 Hypothesis Development

Our theoretical base is the agency theory that we briefly discussed in the introduction. Based on this theory, an improvement in the alignment of management with shareholders is to appoint *non-executive* directors who are *independent* from management control and do *not* have any affiliation with the firm. On this premise, we posit the following three hypotheses.

Hypothesis 1: Board independence reduces litigation risk.

In support of the above hypothesis, we posit that independent directors are more concerned about their reputation than insider directors. Given that their career opportunities are related to their performance, they have strong incentives to maintain, both inside and outside the firm, a level of excellence in their directorship position (Fama, 1980; Fama and Jensen, 1983). Some researchers provide empirical evidence for this argument. For example, Weisbach (1988) finds that poorly performing CEOs are more likely to be replaced by independent directors. Brochet and Srinivasan (2014) provide some evidence that investors are more likely to name independent directors as defendants in securities lawsuits, and they can vote against their re-election to express displeasure over the directors' ineffectiveness at monitoring managers. Jiang et al. (2015) find that career concern of independent directors aligns their interest with shareholders' interest rather than with management's. They find that market rewards their dissenting behavior by offering them more future directorship opportunities. Based on these premises and positions, we expect the independent directors to be more incentivized to monitor managements' activities effectively.

In addition, some researchers report that board independence has a negative impact on a firm's information asymmetry and stock price informativeness. These studies conclude that a higher proportion of independent directors in the boardroom improves the quality of financial reporting and firm transparency (e.g., Petra, 2006; Ferreira et al., 2011; Armstrong et al., 2014; Chen et al., 2014). On these grounds -- that a higher proportion of independent directors increases the monitoring power of the board and the firm's transparency -- we hypothesize that board independence decreases the probability of lawsuits being filed against the company.

Hypothesis 2: The effectiveness of board independence in reducing litigation risk is negatively related to the firm's monitoring costs.

One of the arguments often cast over the efficiency of independent directors is the trade-off between costs and benefits of outside monitoring. In an early study, Demsetz and Lehn (1985) articulate that in an uncertain environment characterized by frequent changes in relative prices, market shares, technology and so forth, monitoring cost is very high and, therefore, independent directors are less efficient. They argue that managers in firms operating in less predictive environments need to make more frequent timely decisions about reallocation of the firms' assets and resources. In noisy environments, the effects of managerial decisions on the firms' performance are compounded by the effects of other, often volatile, exogenous factors. Therefore, the monitoring of managerial behavior would be very difficult and costly. Consistent with this argument, Gillan et al. (2003) provide some empirical evidence that standard deviations of a firm's monthly returns are negatively related with the proportion of independent directors in the boardroom. Coles et al. (2008) argue that the firm-specific knowledge of inside directors is critical for R&D-intensive firms; therefore, they have lower fraction of independent directors on their board. Wintoki (2007) finds that a high level of outside monitoring adversely affects the performance of firms with high monitoring cost proxied by standard deviation of returns and R&D expenditures. Based on these positions, we hypothesize that the effectiveness of board independence in reducing litigation risk is negatively related to the monitoring cost proxied by the standard deviation of returns and R&D expenditure.

Hypothesis 3: The effectiveness of board independence in reducing litigation risk is positively related to the complexity of the firm.

As firms expand their operating business scope and mature, some significant agency problems arise and the monitoring power of independent directors becomes more beneficial (Lehn et al., 2009; Crutchley et al., 2004). Therefore, the complexity of a firm increases the efficiency of the independent directors. Boone et al. (2007) find that firm size, age, and business diversification are positively related to the proportion of the independent directors. Chhaochharia and Grinstein (2007) find that larger firms benefit more from the independent directors. Wintoki (2007) provides some empirical evidence that imposing outsider monitoring carries more beneficial value for more complex firms. Based on these arguments, we hypothesize that board independence is more effective in reducing litigation risk when the firm is operating under a higher level of complexity. We proxy firm complexity by size of assets, age of firms, and having foreign business segments.

1.3 Data and Methodology

1.3.1 Sample selection

We use three main data sources: Audit Analytics Litigation Database (AALD), Institutional Shareholder Service Directors (ISSD), and CRSP/Compustat Merged Database.

AALD tracks all *material* civil litigations for public registrants under SEC regulation S-K §229.103. In this context, m*ateriality* means that it is not trivial to the economic well-being of the company. A set of pre-defined ranges for the calculation of materiality is employed. Based on the audit risk, the auditor will select a value inside the ranges of: 0.5% to 1% of gross revenue; 1% to 2% of total assets; 1% to 2% of gross profit; 2% to 5% of shareholders' equity; and 5% to 10% of net profit. We retain AALD data for only securities litigations. In general, these litigations arise due to securities fraud, defined as a misleading action in violation of securities laws that deceive investors to trade based on false information, frequently resulting in losses. Securities fraud include a wide range of actions including stock manipulation, financial misreporting, lying to corporate auditors, insider trading, and front running.

ISSD (formerly RiskMetrics) provides data on directors other than their financial compensation, like board affiliation. It covers firms included in the S&P1500 (S&P500, S&P MidCaps, and S&P SmallCaps).

CRSP/Compustat provides accounting and market data for the U.S. publicly traded firms. We merge these three data bases based on company Cusip, fiscal year, and the year in which a legal litigation case is filed against the firm.

The period of study is 1998 to 2017. After merging the above three databases, we are left with 24,604 firm-year observations. These observations are reduced due to one or more missing values when matching variables at the empirical level. At minimum, 14,844 firm-year observations are employed in the estimated relations.

1.3.2 Base models

Following Kim and Skinner (2012), our base framework to measure the litigation risk is built on the following probit regression model:

$$Security\ lit_t = B_0 + B_1(FPS_{t-1}) + B_2(Size_{t-1}) + B_3(Sales\ growth_{t-1}) + B_4(Return_{t-1}) + B_5(Return\ skew_{t-1}) + B_6(Return\ sd_{t-1}) + B_7\,(Turnover_{t-1}) + \varepsilon \quad (1)$$

The dependent variable, $Security\ lit_t$, is a binary variable that equals to one if a securities lawsuit is filed against the firm in year t. As suggested by Philbrick and Schipper (1994a), firms in biotech, computer, electronics, and retail industry have higher litigation risks compared to other industries. In order to control for these industries, *FPS*, which is a dummy variable, is set equal to one if the firm is in any one of these four industries. Detailed definitions of variables are included in Appendix A.

To measure the impact of the board independence on litigation risk, we expand relation (1) by adding *Board independence*, measured as the proportion of independent directors to total number of directors in the firm. In addition, we control for a host of additional variables, including board size, CEO duality, board's average age, board's age diversification, R&D intensity, free cash flow, leverage, capital expenditures, tangibility, and ROA. To address potential '*endogeneity'*, we use lag of explanatory variables.

To control for unobserved '*heterogeneity'* and omitted-variable bias, we apply the conditional fixed-effects logit model proposed by Chamberlain (1980). In addition, for further robustness check, we test a linear probability model (LPM) with firm fixed effects. With the inclusion of the fixed effects, LPM is also expected to account for heterogeneity and omitted-variable bias. Overall, in this regard we experiment with four variant models at the estimation stage.

Further, board independence is determined endogenously since the firms with higher *ex-ante* litigation risk may hire independent directors to improve their image and/or manage the pending or future potential cases. Moreover, since independent directors are concerned about their reputations, they might choose to join the firms with lower litigation risk. In order to cope with potential endogeneity, we use a two-stage instrumental variable probit model. We select, empirically verify (see Appendix B), and link two instruments with the board independence ratio variable. The first instrument is a *County ratio* which is measured as the proportion of the total number of independent directors in the county of a firm's headquarters to the total number of directors in that county, excluding the sample firm in question. The second instrument is an *Industry ratio* which is measured by the proportion of the total number of independent directors in the industry (two-digit SIC code) of firm to the total number of directors in that industry, excluding the sample firm in question. These instruments are similar to those used in Balsam et al. (2016). In the first stage, we regress *Board independence* on these two instruments and other covariates (see relation (2) below). Consistent with the two-stage estimation methods, in the second stage we include the predicted value of *Board independence* in a probit regression model (relation (3) below).[2] The estimation of the endogenous probit model is thus done through a two-stage procedure. The estimation method in the second stage is maximum likelihood estimation (MLE).

$$Board\ independence_t = B_0 + B_1(County\ ratio_t)\ ) + B_2(Industry\ ratio_t) + \sum_i B_i(x_{it}) + \varepsilon \qquad (2)$$

$$Security\ lit_t = B_0 + B_1(Board\ \widehat{indpendence}_{t-1}) + \sum_i B_i(x_{it-1}) + \mu \qquad (3)$$

where, x_{it} includes fps, size, sales growth, turnover, return, return standard deviation, return skew, board size, duality, board's average age, board's age diversification, R&D intensity, cash flow, leverage, capital expenditures, tangibility, and ROA. Relation (3) is an expanded version of relation (1) within the framework of a two-stage instrumental variable (IV) probit model.

1.3.3 Expansion of the base models

We expand the base models, relations (2) and (3), to analyze the effect of monitoring cost, firm complexity, and relative benefits and costs of board independence. These expansions are detailed below. In these analyses we have the option to resort to the two stage modeling, i.e., using the predicted estimates of *board independence*, or resort to its actual values. We have opted for the second alternative for simplicity and also because our purpose is focused on the effect of special determinants. For robustness, we also report the outcome of using the predicted values of *board independence* in the latter part of the

[2] We have the option to use the logit model. We have applied this model and have obtained similar supporting results, though marginally different. Our preference for the probit over the logit model is because in the latter the distribution of the error terms in its second stage '*with IV instruments'* is not statistically well-defined.

paper. So, for consistency in use of notations, *Board independence* may be replaced with $Board\ \widehat{independence}$ the following specifications.

1.3.3.1 Monitoring cost

We need to first measure firm's monitoring cost. To do so, we construct a monitoring cost index based on two variables: standard deviation of returns and R&D intensity. We sort firm-year observations into quantiles based, separately, on the standard deviations of the firm's 12-month returns (*Return sd*) and R&D intensity (*R&D*) in an ascending order. Specifically, we sort firms separately on each of the following two variables:

- *Return sd:* lowest to highest
- *R&D:* lowest to highest

We then assign a score of 1 to 5 to each firm-year observation based on its quantile. For each firm-year observation, we sum the scores across the two dimensions (*Return sd* and *R&D*) to establish the monitoring cost index. Finally, we normalize this index by scaling it between 0 and 1.

Further, to measure the difference in the effect of board independence on litigation risk across firms with different monitoring costs, we sort firm-year observations into two groups: firms with low and firms with high cost positions. This division is based on the monitoring cost index relative to the median. We define *high monitoring* as a dummy variable that equals to one if a firm falls into the second group.

We estimate the following probit regression to capture the difference in the effect of board independence on litigation risk across firms with different monitoring costs:

$$Security\ lit_t = B_0 + B_1(Board\ independence_{t-1}) + B_2(High\ monitoring_{t-1}) + B_3(Board\ ind * High\ monitoring_{t-1}) + \sum_i B_i(x_{it-1}) + \mu \qquad (4)$$

The joint variable *Board ind*High monitoring* in relation (4) is the interaction of *board independence* and *high monitoring* dummy variable. The estimate of B_3 is interpreted as the difference in board independence effect on litigation risk between firms with high monitoring costs and firms with low monitoring costs.

In addition, in order to examine how the level of monitoring cost index affects the effect of board independence on litigation risk, we test the following probit regression model which is a variant of relation (4):

$$Security\ lit_t = B_0 + B_1(Board\ independence_{t-1}) + B_2(MC\ index_{t-1}) + B_3(Board\ ind * MC\ index_{t-1}) + \sum_i B_i(x_{it-}\ ) + \mu \qquad (5)$$

The joint variable *Board ind*MC index* in relation (5) is the interaction of *board independence* and monitoring cost index. The estimate of B_3 indicates how the monitoring cost index affects the effects of board independence on litigation risk. Finally, we measure the marginal effect of board independence on litigation risk for different levels of monitoring cost index.

1.3.3.2 Firm complexity

As in the case of the monitoring cost in the above sub-section, we need to construct a measure of complexity for each firm. Data on such a measure are nonexistent. We therefore design an index to capture this measure based on three variables: size, age, and overseas operation (foreign segment). We first sort firm-year observations into quantiles based separately on their total asset (*Size*) and firm age (*Age*) in ascending order. Thus, we sort firms separately on each of the following two variables:

- *Size*: smallest to largest
- *Age*: youngest to oldest

We then assign a score of 1 to 5 to each firm-year observation based on its quantile. To capture the effect of the third variable (global operation or foreign segment) we assign a score of 5 to observations that have a foreign business segment and a score of zero to firms that do not have revenue in a foreign country. For each firm-year observation, we add up the scores across the three dimensions (i.e., *Size*, *Age,* and *Foreign segment*) to construct the complexity index. Finally, we normalize this index by scaling it between 0 and 1.

Further, we sort firm-year observations into two groups, firms with low and firms with high complexity, based on their complexity index. We define *high complexity* as a dummy variable that equals to one if a firm falls into the second group.

Finally, to measure the difference in the effect of board independence on litigation risk across firms with different complexities, we test the following probit model:

$$Security\ lit_t = B_0 + B_1(Board\ independence_{t-1}) + B_2(High\ complexity_{t-1}) + B_3(Board\ ind * High\ complexity_{t-1}) + \sum_i B_i(x_{it-1}) + \mu \qquad (6)$$

The term *Board ind*High complexity* in relation (6) is the interaction of *board independence* and *high monitoring* variable. The estimate of B_3 is interpreted as the difference in board independence effect on litigation risk between firms with high and low complexity.

In addition, in order to examine how the detailed levels of complexity index affects the effect of board independence on litigation risk, we test the following probit regression model which is a variant of relation (6):

$$Security\ lit_t = B_0 + B_1(Board\ independence_{t-1}) + B_2(COM\ index_{t-1}) + B_3(board\ ind * COM\ index_{t-1}) + \sum_i B_i(x_{it-1}) + \mu \qquad (7)$$

The joint variable *Board ind*COM index* in relation (7) is the interaction of *board independence* and complexity index. The estimate of B_3 indicates how complexity index affects the effects of board independence on litigation risk. Moreover, we also measure the marginal effect of board independence on litigation risk for different levels of complexity index.

1.3.3.3 Relative benefits and costs of board independence index (TOTAL Index)

Similar to our procedures in the above two sub-sections, we construct a *TOTAL index* to capture the relative trade-offs between the benefits and costs of independent directors for firms. We employ five variables. We sort firms into quantiles separately on the first four variables: standard deviation of 12-month return (*Return sd*), R&D expenditure (*R&D*), total assets (*Size*), and firm age (*Age*). The sort is controlled so that the lowest (highest) quantile values indicate firms that are predicted to have the lowest benefit or highest cost (highest benefit or lowest cost) due to having independent directors. Specifically, we sort firms on each of the following four variables:

- *Return sd:* highest to lowest
- *R&D:* highest to lowest
- *Size*: smallest to largest

- *Age*: youngest to oldest

We assign a score of 1 to 5 to each firm-year observation based on its quantile when sorted on each of the above variables. We then consider the fifth variable, i.e., foreign operation, and assign a score of 5 to observations that have a foreign business segment and a score of zero to firms that do not have revenue in a foreign country. For each firm-year observation, we add up the scores across the four dimensions i.e., *Return sd*, *R&D, Size, Age,* and *Foreign segment*, to construct the relative benefit and cost of board independence index (*TOTAL index*). Finally, we normalize this index by scaling it between 0 and 1.

Finally, in order to examine how the *TOTAL index* affects the effect of board independence on litigation risk, we run the following probit regression model:

$$Security\ lit_t = B_0 + B_1(Board\ independence_{t-1}) + B_2(TOTAL\ index_{t-1}) + B_3(Board\ ind * TOTAL\ index_{t-1}) + \sum_i B_i(x_{it-1}) + \mu \qquad (8)$$

The term *Board ind*TOTAL index* in relation (8) is the interaction of *board independence* and *TOTAL index*. The estimate of B_3 indicates how *TOTAL index* affects the effect of board independence on litigation risk. As in the other tests, we also measure marginal effect of board independence on litigation risk for different levels of *Total index.*

1.4 Summary Statistics of the Variables

Table 1.1 summarizes descriptive statistics of all the variables.[3] The average of *Board independence* is 0.73 which means that, on the average, 73 percent of directors of firm-year observations in our sample are independent. The mean value of the *FPS* dummy

[3] To reduce the influence of outliers, we winsorize all variables at 1st and 99th percentiles.

variable is 0.26, indicating that 26 percent of firm-year observations are operating in biotech, computer, electronics, and retail industry. Overall, 4.9 percent of firm-year observations in our sample are involved in securities litigations.

< Insert Table 1.1 here >

Table 1.2 provides the number and percentage of firm-year litigations in our sample by industry. Firms operating in securities & commodity brokers, dealers, exchanges & services, educational services and agricultural productions (crops) have the highest rate of securities litigations in our sample.

< Insert Table 1.2 here>

Figure 1.1 presents the percentage of firms involved in material securities litigations per year in our sample. There is a dramatic upward trend in securities litigations from 1998 to 2004 when the average percentage of firms increases from 3.3% to around 7% percent. However, from 2005 to 2007, there is a sharp downward trend in securities litigations. This sharp decline can be attributed to the passage of Sarbanes–Oxley Act (SOX) in 2002 and the adoption of a more restrictive set of listing rules by the major stock exchanges, NYSE and NASDAQ, in 2003. The U.S. Congress enacted SOX, and major stock exchanges adopted a stricter set of requirements in response to major accounting misconducts in the early 2000s.[4] One of the important consequences of SOX and the new exchange listing was an increase in board independence since they require publicly traded firms to have a majority of independent directors on boards. Moreover, their essential provisions include independence of audit committee and stricter definition of

[4] Major examples of these misconducts are Enron Corporation, Tyco International plc, Adelphia, Peregrine System, and WorldCom.

independence. Therefore, the sharp decline in percentage of firms hit by securities lawsuits in 2005 and 2006 can be linked to an increase in board independence.

From 2007 to 2015, the average percentage of firms involved in securities litigations fluctuates between 3.3% and 5.3%. There is a sharp upward trend in securities litigations in 2016 and 2017 where the numbers increase from 3.5% to 8.5%. It appears that this dramatic upward trend is due to the Delaware court's hostility to disclosure-only settlements of merger objection lawsuits that make the plaintiffs' attorneys file merger objection lawsuits in federal court rather than in state court.

< Insert Figure 1.1 here >

1.5 Empirical Results

1.5.1 Test of hypothesis 1: Board independence reduces litigation risk

We first estimate four variants of relation (3). The first two variants are all under a probit modelling procedure while the third variant is under a fixed-effects conditional logistic modeling.[5] The fourth variant is a linear probability model (LPM) that also includes firm fixed effects. This model (LPM) is intended to provide further robustness check. It also represents a standard estimation methodology that has often been used in prior econometric literature, though not in the context of litigation risk analysis. The results are reported in Table 1.3. The results of an expanded version of probit regression with instrumental variables that account for endogeneity are provided and discussed later in Table 1.4 and in Appendix B.

[5] Fixed-effects conditional probit modeling lack sufficient statistics to allow the fixed effects to be conditioned out of the likelihood function.

Column 1 (Table 1.3) includes all the variables. It indicates that the coefficient of *board independence* is negative and statistically significant at the 1 percent level. The marginal effect of *board independence* on probability of filing a securities lawsuit against the firm (i.e., dy/dx) is -0.0335 and is also statistically significant at the 1 percent level.

Column 2 replaces the industry variable (*FPS*) with industry fixed effects based on two-digit SIC codes.[6] The coefficient of *board independence* is still negative and statistically significant at the 5 percent level. The marginal effect of *board independence* on probability of a securities lawsuit filing against the firm is - 0.0283 and is statistically significant at the 5 percent level.

In order to control for unobserved heterogeneity and omitted-variable bias, we apply the conditional fixed-effects logit model proposed by Chamberlain (1980). The results are in column 3 of Table 1.3. We include firm fixed effects in the model. The coefficient of *board independence* is still negative and statistically significant at the 5 percent level. The marginal effect of *board independence* on probability of a securities lawsuit filing against the firm is - 0.058 and is statistically significant at the 1 percent level.

Finally, column 4 of Table 1.3 includes the results of the linear probability model (LPM) with firm fixed effects.[7] The average marginal effect of *board independence* on probability of filing a securities lawsuit against the firm is - 0.0386 and is statistically significant at the 5 percent level. Overall, the results in Table 1.3 show that board independence has a negative effect on litigation risk.

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[6] We employ 2-digit SIC codes. These codes are not collapsed or absorbed into a smaller number as some software automatically do so, c.f., 'Areg' in STATA.

[7] 1801 firm fixed effects are included at this level. Also, see footnote 7.

<Insert Table 1.3 here>

We now consider relation (3) in light of relation (2), i.e., litigation risk within the framework of a two-stage endogenous probit model. We consider instruments that are correlated with *board independence* but uncorrelated with litigation risk. We employ *'county ratio'* of independent directors (excluding the sample firm) and *'industry ratio'* of independent directors (excluding the sample firm), discussed in Section 1.3.2, as instrumental variables (IV). We conduct several tests to confirm that these instruments meet the requirements of '*relevance*' and *'exclusion'* conditions (see, for instance, Nash and Patel, 2019). See Appendix B for the empirics in this regard. The county-based instrument is relevant because the board structures of the included firms in a county are unlikely to affect the litigation risk of the selected (=excluded) firm directly, though they may be correlated with the selected firm's board structure in the same county. It is possible that factors that motivate the included firms to consider independent directors may also affect the selected (=excluded) firm's board structure in the same county. The industry-based instrument is also suitable because the board structures of the included firms in one industry are unlikely to affect the litigation risk of the selected (=excluded) firm in the same industry directly, although again it is possible that factors that motivate the included firms in the same industry to consider independent directors may also affect the board structure of the selected firm in the same industry.

The results of estimating relations (2) and (3) are presented in Table 1.4. Column 1 includes the results of regression of *board independence* on the above two instruments (county and industry ratios) and other covariates detailed in relation (2). Both instruments are positively and statistically significantly correlated with the *board independence*. This confirms one of the tests on the *'relevance condition'* of instrumental variables (see, for instance, Nash and Patel, 2019). We note that this test is relatively stringent since all control variables are accounted for in the test. The test also holds very well in a univariate setting (see Appendix B). The estimated coefficients of county and industry ratios are 0.0369 and 0.282, respectively, and are statistically significant at the 5 percent and 1 percent levels. We also perform an additional '*relevance condition*' test for the strength of these instruments. The partial F-statistic of 55.91 indicates that the instruments exhibit sufficient power in explaining the board independence ratio.[8] Further, to address the *'exclusion condition'* of instrumental variables, we conduct an over-identification test that yields a value of 2.034 (p-value = 0.1538) for Amemiya-Lee-Newey minimum Chi-square statistics. This confirms that the over-identification restrictions are valid.[9]

Column 2 (Table 1.4) includes the results of estimating litigation risk within the framework of a two-stage endogenous probit model, i.e., relation (3) using the predicted values of relation (2). The coefficient of the predicted board independence ratio is -1.041 and is statistically significant at the 1 percent level. The marginal effect of the predicted board independence on probability of filing a lawsuit against the firm is - 0.0834 and is statistically significant at the 1 percent level. These results indicate that board

[8] Stock et al. (2002) suggest a minimum of 10.

[9] It is often noted that the '*exclusion condition'* is untestable. Often, theoretical explanations are provided, or qualitative justifications are inferred. Further, though over-identification tests are frequently employed in this regard, they are not primarily tests of exogeneity, but rather tests of the validity of the additional IV restrictions imposed (Parente and Silva, 2012).

independence ratio has a negative effect on securities litigation risk, even after controlling for endogeneity.

< Insert Table 1.4 here>

1.5.2 Test of hypothesis 2: The effectiveness of board independence in reducing litigation risk is negatively related to the firm's monitoring costs

Based on our coverage in section 1.3.3.1, to measure the effect of board independence on litigation risk across firms with different monitoring costs, we estimate two probit model specifications based on relations (4) and (5). Relation (4) includes a binary measure of monitoring costs whereas relation (5) uses a continuous measure that we refer to as monitoring cost level (*MC index*). Table 1.5, Panel A, columns 1 and 2 present the results of relation (4) and columns 3 and 4 include the results of relation (5). The differences between columns 1 and 2, and 3 and 4, are inclusion/exclusion of the variable FPS and industry fixed effects, i.e., in columns 2 and 4 we drop *FPS* and instead include industry fixed effects. Inclusion of both FPS and industry effects together in each specification is not warranted since it causes collinearity.

The coefficient of interaction of *Board independence* and *High monitoring* (*Board ind*High monitoring*) is positive and statistically significant at the 1 percent level (Table 1.5, Panel A, columns 1 and 2). So is the case when the continuous index, *MC index*, is used (columns 3 and 4). Panel B in Table 1.5 provides the marginal effects of board independence for firms with high and low monitoring cost in the two specifications in relation (4). For instance, column 1 in this panel includes the average marginal effect of *Board independence* on the probability of being hit by a securities lawsuit for firms with low monitoring cost (*High monitoring*=0) and for firms with high monitoring cost (*High* *monitoring*=1) based on the estimates in column 1 of Panel A. Average marginal effect for firms with low monitoring cost is - 0.055 and is statistically significant at the 1 percent level. However, average marginal effect of board independence for firms with high monitoring cost is - 0.0131 and is not statistically significant. Similarly, column 2 (in both Panels A and B) confirm the same results.

The above results indicate consistently that independent directors are effective in reducing the securities litigation risk only in firms with low monitoring costs. In other words, as the monitoring cost increases, the effectiveness of independent directors in reducing the securities litigation decreases.

<Insert Table 1.5 here>

1.5.3 Test of hypothesis 3: The effectiveness of board independence in reducing litigation risk is positively related to firm complexity

As we discussed in section 1.3.3.2, in order to examine how the effect of board independence on litigation risk varies across firms with different complexity, we estimate two probit models based on specifications detailed in relations (6) and (7). In brief, we replicate the above analysis of monitoring costs with the two measures of firm complexity that we constructed in section 1.3.3.2. The estimation results are presented in Table 1.6. The structure of this table is similar to Table 1.5, except for its very last two columns that are included to save space. These last two columns will be discussed separately. We therefore withhold from further discussing the structure of this Table.

The coefficient of interaction of *Board independence* and *High complexity* (*Board ind*High complexity*) is negative and statistically significant at the 1 percent level. The average marginal effect of *Board independence* for firms with low complexity is - 0.0167 and is not statistically significant. However, the estimate for firms with high complexity is - 0.0485 and is statistically significant at the 1 percent. The same conclusions are reached in the specifications with FPS or with industry fixed effects, or in specifications that include our continuous measure of firm complexity, i.e., *COM index,* in the two specifications that are tested on relation (7). For instance, under industry fixed effects, corresponding estimates are still negative and statistically significant at the 1 percent level; the marginal effect for firms with low complexity is - 0.0109 and is not statistically significant, while the same estimate for firms with high complexity is - 0.0486 and is statistically significant at the 1 percent.

These above results consistently indicate that independent directors are effective in reducing the securities litigation risk only in firms with high complexity. Board independence have no effect on litigation risk in firms with low complexity.

<Insert Table 1.6 here>

1.5.4 Test of relative benefits and costs of board independence

We posited relation (8) in section 1.3.3.3 as a methodology to examine how the relative benefits and costs of board independence affect the effectiveness of independent directors in reducing litigation risk. We now discuss the estimates of this relation. The results are already included in the very last two columns of Table 1.6.[10] The structure of these two columns are also already well established. Therefore, we withhold from further elaboration.

[10] We chose this Table which is on firm complexity for brevity and to save space.

The coefficient of interaction of *Board independence* and Total index (*Board ind*TOTAL index*) is negative and statistically significant at the 5 percent level, indicating that the effectiveness of independent directors in reducing the securities litigation risk is positively related to the relative benefits and costs of having independent directors. This conclusion holds for both specifications, i.e., with FPS or with industry fixed effects in the specifications.

The above results indicate that as the *TOTAL index* increases, the effectiveness of independent directors in reducing the securities litigation increases as well. This is *tantamount t*o stating that in general, considering the monitoring cost and firm complexity, the effect of board independence in reducing securities litigation risk is positive.

1.5.5 Marginal effects of board independence under variations in monitoring cost, firm complexity, and total index

We also estimate the marginal effects of board independence on probability of a securities lawsuit filing against the firm for different levels of monitoring costs (hypothesis 2), firm complexity (hypothesis 3), and total effect (constructed index on joint H1 and H2). The results are reported in Table 1.7. The inputs to these estimations are, respectively, column 4 of Table 1.5, and columns 5 and 6 of Table 1.6. Other variations based on other columns of these Tables may be designed.

As the monitoring costs increase, the marginal effect of *board independence* on probability of being hit by a securities lawsuit moves from negative to positive values. The marginal effects of *board independence* are negative and statistically significant when monitoring costs are less than 0.5. When the monitoring costs are higher than this value, the marginal effects of *board independence* are consistently statistically insignificant.

Figure 1.2.a graphically depicts these results. Overall, these results indicate that independent directors' effectiveness in reducing securities litigation decreases as firm's monitoring cost increases.

<Insert Table 1.7 here>

<Insert Figure 1.2 here>

As firm complexity increases, the marginal effects of *board independence* on probability of being hit by a securities lawsuit move from positive to negative values. The marginal effects of *board independence* are statistically insignificant when complexity is less than 0.5. When firm complexity is higher than this value, the marginal effects of *board independence* are negative and statistically significant. Figure 1.2.b graphically depicts these results. Overall, these results indicate that independent directors' effectiveness in reducing the securities litigation increases as the firm complexity increases.

Finally, as the *TOTAL index* increases, the marginal effects of *board independence* on the probability of being hit by a securities lawsuit moves from positive to negative values. The marginal effects of *board independence* are statistically insignificant when *TOTAL index* is less than 0.6. When *TOTAL index* is higher than this value, the marginal effects of *board independence* are negative and statistically significant. Figure 1.2.c graphically depicts these results. Overall, these results indicate that independent directors' effectiveness in reducing the securities litigation increases as the relative benefits and costs of having independent directors' increases.

1.5.6 Further robustness checks

As further robustness checks, we conduct three sets of experiments focusing on monitoring costs, firm complexity, and total index. In all these experiments we segment the data into two groups based on the values of each of these variables.

Monitoring costs. We first sort firm-year observations into two groups based on low and high monitoring costs. We then estimate the expanded version of relation (1) on each of these two groups. Table 1.8 presents the results. For firms with '*low'* monitoring costs, the average marginal effect of *board independence* on probability of a firm being hit by a securities lawsuit is negative and statistically significant at the 5 percent level. However, for firms with '*high'* monitoring cost, the average marginal effect of *Board independence* is statistically insignificant.

Firm complexity. We run similar segmented analysis based on firm complexity. We sort firm-year observations into two groups: firms with low and firms with high complexity. We then estimate the expanded version of relation (1) for each of these two groups. Table 1.9 presents the results. For firms with '*low'* complexity, the average marginal effect of *board independence* on the probability of a securities lawsuit filing against the firm is statistically insignificant. In contrast, for firms with '*high'* complexity, the average marginal effect of *board independence* is negative and statistically significant at the 5 percent level.

Endogeneity. Further, we consider endogeneity while examining how monitoring costs and firm complexity influence the effectiveness of board independence on litigation risk. We replicate the above analysis, but in this instance under relations (2) and (3) for each of the groups separately (four in total). Table 1.10 reports the results.

Columns 1 and 2 show the results of the second stage of the probit model for firms with low and firms with high monitoring costs, respectively. For firms with low monitoring cost, the average marginal effect of the predicted *board independence* on the probability of a securities lawsuit filing against the firm is - 0.15 and is statistically significant at the 1 percent. However, for firms with high monitoring cost, the marginal effect of predicted board independence is statistically insignificant.

Columns 3 and 4 present the results of the second stage of the probit model for firms with low and firms with high complexity, respectively. For firms with low complexity, the average marginal effect of the predicted *board independence* on the probability of a securities lawsuit filing against the firm is statistically insignificant. In contrast, for firms with high complexity, the marginal effect of predicted *board independence* is - 0.20 and is statistically significant at the 1 percent level.

The above further confirm the robustness of our results. In addition, our experiments with longer lags, i.e., two- and three-year lags, of *board independence* remain robust. The results are also robust if the lagged value of *securities litigation* is included in the probit regression models. Further, similar results are obtained when we construct the firm complexity index on the basis of number of employees, number of business segments, market capitalization, firm age, and whether or not the firm possesses a foreign business segment.[11]

[11] For brevity, these results are not included but are available from the first author.

1.6 Conclusions

In quest of reducing the burden of litigations that arise from their numbers, costs, and the negative public image they cause, firms have been often on their toes to take some measures in the pre- and post-occurrences of litigation cases. In the pre-cases, the attention has mostly been on quality and internal process control. In the post cases, the attention shifts to legal matters and minimization of settlement costs, including fees and expenses for courts, attorneys, and expert witnesses. In this paper, we open an additional venue that would be effective, though indirectly, towards achieving the above objectives. This venue, which draws upon the agency theory, is related to the composition of firms' board members, i.e., the number of independent board directors relative to the total number of board directors. Our findings indicate that, irrespective of the 'other' reasons for having been appointed as an independent board member, the independent board members are also effective in reducing the securities litigation risks. It is not clear if this positive feature of the independent board directors has been a consideration in appointing them.

Given the sharp increases in the percentage of firms involved in securities litigation since 2015 (see Fig. 1), mitigating the securities litigation risk and its associated costs is a significant item in firms' governance. In addition to their costs, securities litigations have also considerable effect on firm's liquidity and investment policy. Over the past two decades, the percentage of firms involved in securities litigation appears periodic. For instance, there was a sharp rise during the 1998-2002 period, then it was relatively flat over 2006-2014, followed by a rising trend starting in 2015. The average settlement costs for the 2015-2018 period is 34 million dollars, with a range of $71 thousand to $900 million. Therefore, the current challenge is to identify strategies to reduce costs, or equivalently, the probability of litigation occurrences as we have covered it in this paper. We have documented that composition of the board members is an instrumental strategy in controlling or reducing litigations risks.

We provide substantial empirical evidence on the effectiveness of board independence on reducing securities litigation risk. In addition, our findings indicate that the effectiveness of independent directors is subject to some limitations. For instance, independent directors are not effective in reducing the litigation risk in firms with high operational uncertainty. Indeed, as monitoring cost increases, the effectiveness of independent directors in reducing litigation risk decreases. Our results also indicate that independent directors are more effective in reducing litigation risk in firms with a higher level of complexity. To cite some of our findings, overall, the average marginal effect of board independence ratio on litigation risk is around -2.6 percent, i.e., if the proportion of independent directors increases from zero to one, the mean of the probability of a securities lawsuit filing against the firm decreases by 2.6 percent. This figure is about -5.0 percent for firms with low monitoring cost, and -4.8 percent for firms with high complexity, As the level of complexity increases, the effectiveness of independent directors in reducing litigation risk increases consistently.

The above findings support the notion that independent directors have more incentives than insider directors to monitor management's activities effectively. Further, they provide important implications for policy makers, regulators, shareholders, insurers, and management. They also offer substantial insight into setting firms' liquidity and investment strategies, Our findings also imply that 'one-size-fits-all governance remedies' to reduce litigation risk might be suboptimal. Internal governance requirements should not necessarily be the same for all types of firms. It might be more optimal to set different internal governance requirements based on the operational uncertainty, monitoring costs, and firm complexity.

Figure 1.1. Litigation trends
This figure depicts the percentage of firms involved in material securities litigations per year in our sample.

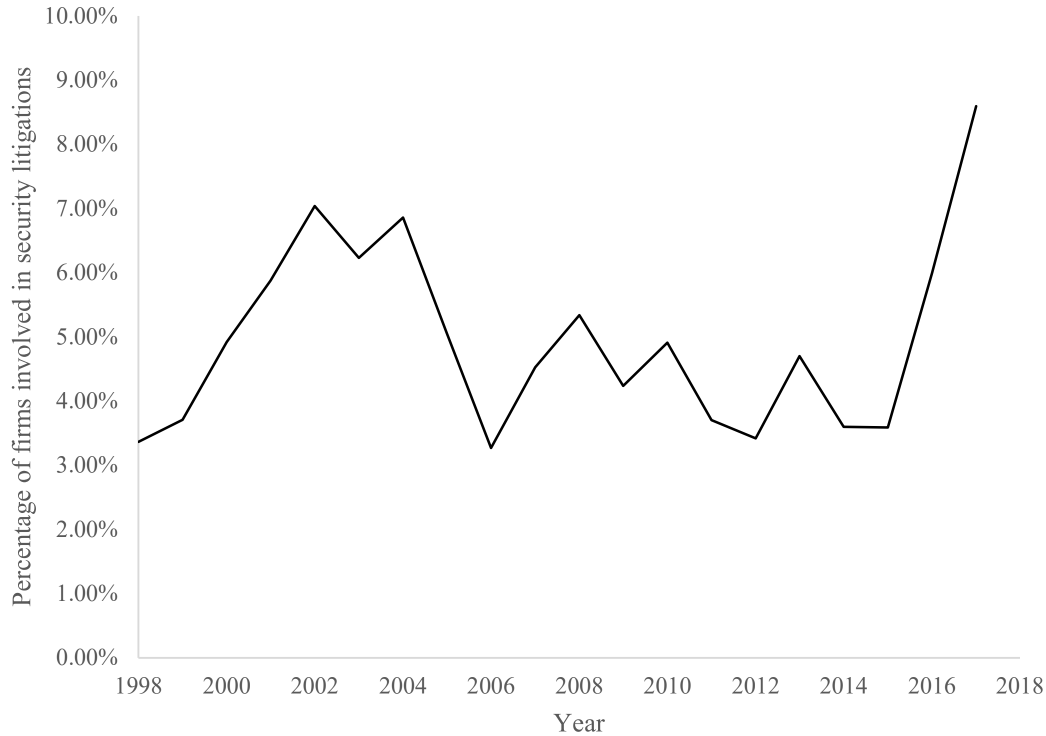

Figure 1.2. Average marginal effect of board independence on probability of filing a securities lawsuit

Average marginal effects of board independence on probability of a securities lawsuit filing against a firm are depicted for different levels of MC index, COM index, and TOTAL index in Figures 2.a, 2.b, and 2.c, respectively. These marginal effects are based on the estimates presented in Table 1.5 (col 4) and Table 1.6 (cols 4 and 6), respectively. The average marginal effects of board independence on probability of a securities lawsuit filing are shown by solid black lines. The 95 percent confidence intervals for the average marginal effects are shown by dashed red lines.

Figure 1.2.a

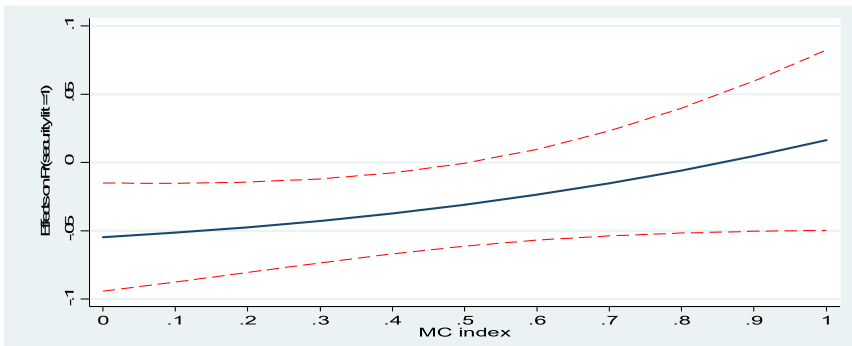

Figure 1.2.b

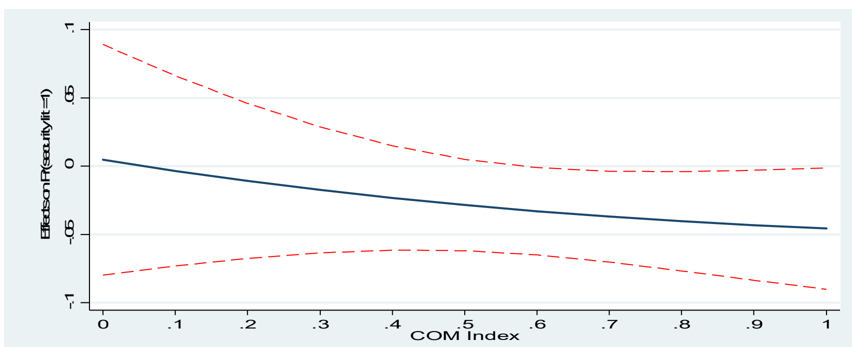

Figure 1.2.c

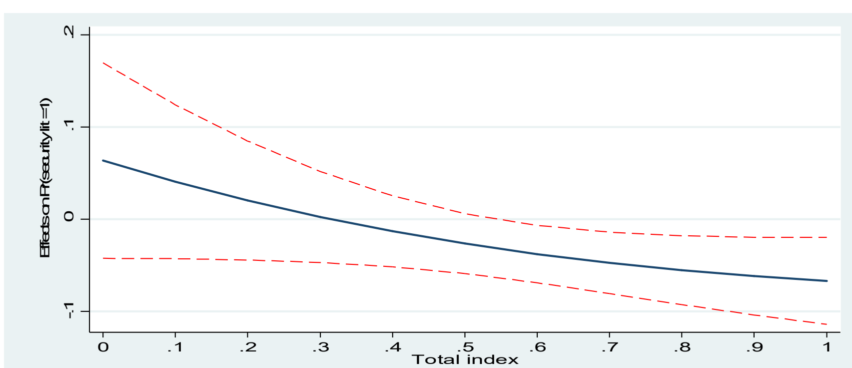

Table 1.1. Summary statistics

This Table summarizes descriptive statistics of the major variables used in this study. N is number of observations. Mean is the average of firm-year observations. Min is minimum of firm-year observations. Max is maximum of firm-year observations. SD is the standard deviation of firm-year observations. Skew is skewness of firm-year observations. P1 is the 1th percentile of firm-year observations. P50 is the 50th percentile of firm-year observations and P99 is the 99th percentile of firm-year observations.

Variables	N	Mean	Min	Max	Sd	p1	p50	p99
Duality	24,604	0.4530	0.0000	1.0000	0.4980	0.0000	0.0000	1.0000
Board independence	24,604	0.7330	0.0000	1.0000	0.1560	0.5000	0.7690	0.9000
Board age diversification	24,601	7.8160	3.2390	14.6600	2.4210	4.9550	7.4960	11.1100
Board average age	24,603	61.1000	49.6000	71.2200	4.2050	55.6300	61.3300	66.1400
County ratio	22,493	0.7390	0.0000	1.0000	0.0956	0.6080	0.7630	0.8380
Industry ratio	24,525	0.7370	0.1110	0.9310	0.0892	0.6080	0.7620	0.8290
securities lit	24,604	0.0492	0.0000	1.0000	0.2160	0.0000	0.0000	0.0000
fps	24,604	0.2580	0.0000	1.0000	0.4380	0.0000	0.0000	1.0000
Insider own	24,587	0.0754	0.0000	0.6420	0.1170	0.0039	0.0274	0.2150
Board size	24,604	2.3110	1.3860	3.5550	0.2420	1.9460	2.3030	2.6390
Foreign segment	24,604	0.5340	0.0000	1.0000	0.4990	0.0000	1.0000	1.0000
Free cash	20,781	0.0796	-0.1800	0.2660	0.0652	0.0143	0.0785	0.1560
Capex	23,967	0.0456	-0.0009	0.9650	0.0518	0.0019	0.0312	0.0999
Leverage	24,498	0.2280	0.0000	0.7640	0.1810	0.0000	0.2130	0.4740
R&D	24,604	0.0246	0.0000	0.2310	0.0465	0.0000	0.0000	0.0901
Tangibility	23,642	0.2490	0.0018	0.8790	0.2340	0.0156	0.1720	0.6380
ROA	24,596	0.0419	-0.3600	0.2460	0.0825	-0.0207	0.0427	0.1260
Size	22,326	7.8940	4.7380	12.4600	1.6690	5.8350	7.7460	10.2000
Sales growth	20,215	0.0518	-0.5600	0.5970	0.1610	-0.0855	0.0348	0.2290
Turnover	24,596	22.6800	2.2210	91.5600	16.6600	7.3360	18.0500	44.0300
Return sd	24,594	0.0937	0.0258	0.3190	0.0555	0.0411	0.0790	0.1640
Return skew	24,567	0.1170	-1.5060	1.8920	0.6660	-0.7090	0.0973	0.9810
Return	24,596	0.0058	-0.0778	0.0976	0.0294	-0.0279	0.0050	0.0402
Firm age	24,604	24.4400	0.0000	67.0000	15.7000	6.0000	21.0000	48.0000
High monitoring	24,594	0.4670	0.0000	1.0000	0.4990	0.0000	0.0000	1.0000
MC index	24,594	0.4300	0.0000	1.0000	0.2990	0.0000	0.3750	0.8750
High complexity	22,326	0.4360	0.0000	1.0000	0.4960	0.0000	0.0000	1.0000
COM index	22,326	0.5240	0.0000	1.0000	0.2650	0.1540	0.5380	0.9230
Total Index	22,319	0.5440	0.0000	1.0000	0.1990	0.2860	0.5710	0.8100

Table 1.2. Number of securities lawsuits by industry

This table provides the number and percentage of firm-year observations in our sample that are involved in material securities litigations against them by industry. The industry classification is based on two-digit SIC codes. Percentages are calculated by dividing the number of lawsuits in each industry by the total number of firm-year observations for that industry.

SIC Code	**Description**	**Number of firm years in Sample**	**Number of firm years involved in litigation**	**Percentage of firm years involved in litigation**
01	Agricultural Production - Crops	28	3	10.71%
02	Agricultural Production - Livestock and Animal Specialties	9	0	0.00%
07	Agricultural Services	13	0	0.00%
10	Metal Mining	51	4	7.84%
12	Coal Mining	23	2	8.70%
13	Oil and Gas Extraction	730	25	3.42%
14	Mining and Quarrying of Nonmetallic Minerals, Except Fuels	72	2	2.78%
15	Construction - General Contractors & Operative Builders	205	3	1.46%
16	Heavy Construction, Except Building Construction, Contractor	119	4	3.36%
17	Construction - Special Trade Contractors	44	1	2.27%
20	Food and Kindred Products	637	27	4.24%
21	Tobacco Products	62	2	3.23%
22	Textile Mill Products	83	0	0.00%
23	Apparel, Finished Products from Fabrics & Similar Materials	214	7	3.27%
24	Lumber and Wood Products, Except Furniture	159	2	1.26%
25	Furniture and Fixtures	145	3	2.07%
26	Paper and Allied Products	355	7	1.97%
27	Printing, Publishing and Allied Industries	255	1	0.39%
28	Chemicals and Allied Products	1676	105	6.26%
29	Petroleum Refining and Related Industries	174	5	2.87%
30	Rubber and Miscellaneous Plastic Products	231	5	2.16%
31	Leather and Leather Products	96	2	2.08%
32	Stone, Clay, Glass, and Concrete Products	134	3	2.24%
33	Primary Metal Industries	395	9	2.28%

34	Fabricated Metal Products	356	3	0.84%
35	Industrial and Commercial Machinery and Computer Equipment	1396	58	4.15%
36	Electronic & Other Electrical Equipment & Components	1700	74	4.35%
37	Transportation Equipment	670	28	4.18%
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	1320	60	4.55%
39	Miscellaneous Manufacturing Industries	180	10	5.56%
40	Railroad Transportation	82	1	1.22%
41	Local & Suburban Transit & Interurban Highway Transportation	7	0	0.00%
42	Motor Freight Transportation	198	5	2.53%
44	Water Transportation	74	2	2.70%
45	Transportation by Air	190	5	2.63%
47	Transportation Services	83	3	3.61%
48	Communications	392	37	9.44%
49	Electric, Gas and Sanitary Services	1403	65	4.63%
50	Wholesale Trade - Durable Goods	530	13	2.45%
51	Wholesale Trade - Nondurable Goods	290	15	5.17%
52	Building Materials, Hardware, Garden Supplies & Mobile Homes	64	5	7.81%
53	General Merchandise Stores	257	16	6.23%
54	Food Stores	104	7	6.73%
55	Automotive Dealers and Gasoline Service Stations	163	4	2.45%
56	Apparel and Accessory Stores	375	7	1.87%
57	Home Furniture, Furnishings and Equipment Stores	136	5	3.68%
58	Eating and Drinking Places	412	11	2.67%
59	Miscellaneous Retail	373	23	6.17%
60	Depository Institutions	1633	109	6.67%
61	Non-depository Credit Institutions	164	24	14.63%
62	Securities & Commodity Brokers, Dealers, Exchanges & Services	461	92	19.96%
63	Insurance Carriers	1029	62	6.03%
64	Insurance Agents, Brokers and Service	139	13	9.35%
65	Real Estate	34	0	0.00%
67	Holding and Other Investment Offices	971	13	1.34%

70	Hotels, Rooming Houses, Camps, and Other Lodging Places	45	2	4.44%
72	Personal Services	95	7	7.37%
73	Business Services	2287	129	5.64%
75	Automotive Repair, Services and Parking	66	4	6.06%
78	Motion Pictures	60	4	6.67%
79	Amusement and Recreation Services	117	4	3.42%
80	Health Services	352	33	9.38%
82	Educational Services	88	13	14.77%
83	Social Services	12	0	0.00%
87	Engineering, Accounting, Research, and Management Services	318	14	4.40%
99	Non-classifiable Establishments	68	8	11.76%
	Total	**24604**	**1210**	**4.92%**

Table 1.3. The effect of board independence on litigation risk

This table presents the results of four regression models where the dependent variable is securities litigations, a dummy variable that equals 1 if a securities lawsuit filing against the firm occurs during the year, and 0 otherwise. Columns 1 and 2 present the results of probit regressions without and with including industry fixed effects, respectively. Columns 3 and 4 present the results of conditional fixed logit and linear probability model (LPM), respectively. The term dy/dx indicates average marginal effects of board independence on probability of a securities lawsuit filing against a firm. The variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1) Probit (FPS)**	**(2) Probit**	**(3) Conditional Logit**	**(4) LPM**
$Board\ independence_{t-1}$	-0.377***	-0.325**	-1.022**	-0.0386**
	(-2.590)	(-2.098)	(-2.116)	(-1.974)
$Board\ average\ age_{t-1}$	0.000982	0.00449	0.0136	0.000392
	(0.179)	(0.774)	(0.593)	(0.457)
$Board\ age\ diversification_{t-1}$	-0.000527	-0.00114	-0.0292	-0.000169
	(-0.123)	(-0.227)	(-0.957)	(-0.406)
$Board\ size_{t-1}$	0.0649	0.00528	0.829**	0.0373**
	(0.608)	(0.0476)	(1.983)	(2.160)
$Duality_{t-1}$	0.0759*	0.0577	0.122	0.00559
	(1.827)	(1.335)	(0.976)	(1.132)
$Insider\ own_{t-1}$	-0.190	-0.153	-0.654	-0.0278
	(-1.024)	(-0.827)	(-0.827)	(-1.045)
$Size_{t-1}$	0.215***	0.208***	0.771***	0.0384***
	(14.06)	(12.32)	(5.402)	(6.411)
$Sales\ growth_{t-1}$	0.324***	0.336**	0.260	0.0115
	(2.633)	(2.552)	(0.810)	(0.911)
$Turnover_{t-1}$	0.00400***	0.00547***	0.00523	0.000183
	(2.912)	(3.644)	(1.024)	(0.807)
$Return_{t-1}$	-3.766***	-3.651***	-4.755***	-0.325***
	(-5.318)	(-5.053)	(-2.928)	(-4.524)
$Return\ sd_{t-1}$	3.706***	3.797***	3.003**	0.239***
	(7.076)	(6.981)	(2.201)	(3.937)
$Return\ skew_{t-1}$	-0.0378	-0.0416	-0.0309	-0.00179
	(-1.281)	(-1.379)	(-0.453)	(-0.639)
$Capex_{t-1}$	0.0939	0.278	1.076	0.0661
	(0.153)	(0.420)	(0.546)	(0.876)
$R\&D_{t-1}$	0.923*	1.458***	2.937	0.130
	(1.918)	(2.693)	(0.996)	(0.938)
ROA_{t-1}	-0.0457	-0.0476	0.498	0.0221

	(-0.137)	(-0.138)	(0.536)	(0.547)
$Leverage_{\ t-1}$	0.485***	0.401***	0.342	0.00636
	(4.098)	(2.984)	(0.633)	(0.292)
$Tangibility_{\ t-1}$	-0.685***	-0.829***	-1.848**	-0.100***
	(-5.338)	(-4.494)	(-2.121)	(-2.797)
$Free\ cash_{\ t-1}$	0.839*	0.847*	0.565	0.0361
	(1.947)	(1.859)	(0.418)	(0.650)
$FPS_{\ t-1}$	0.0942*			
	(1.953)			
$Constant$	-4.107***	-3.623***		-0.336***
	(-9.952)	(-5.760)		(-4.574)
Year dummies	Yes	Yes	Yes	Yes
Fixed effects	FPS	Industry	Firm	Firm
dy/dx	-.0335**	-.0283**	-.058***	-.0386**
	(-2.590)	(-2.098)	(-6.543)	(-1.974)
R-squared\Pseudo R-squared	0.100	0.132	0.071	0.073
Observations	14,844	14,844	5,142	14,844

Table 1.4. The effect of board independence on litigation risk -- IV approach

This table presents the results of IV probit regression where the dependent variable in column 2 is securities litigation, a dummy variable that equals 1 if a securities lawsuit filing against the firm occurs during the year, and 0 otherwise. Column 1 presents results of first stage regression where board independence is regressed on two instrumental variables, county and industry ratios, and other covariates. The predicted value of board independence from the first stage regression is used in the second stage probit model. The term dy/dx indicates average marginal effects of the predicted board independence on probability of a securities lawsuit filing against a firm. Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Variables	**(1) First Stage**	**(2) Second Stage**
$Predicted\ Board\ independence_{\ t-1}$		-1.049***
		(-2.636)
$County\ ratio_{\ t-1}$	0.0369**	
	(1.974)	
$Industry\ ratio_{\ t-1}$	0.282***	
	(10.39)	
$Board\ average\ age_{\ t-1}$	4.71e-06	0.00149
	(0.0134)	(0.254)
$Board\ age\ diversification_{t-1}$	-0.00180	-0.00250
	(-1.268)	(-0.747)
$Board\ size_{\ t-1}$	0.0373***	0.0230
	(5.378)	(0.208)
$Duality_{\ t-1}$	0.0337***	0.0728*
	(13.91)	(1.812)
$Insider\_own_{\ t-1}$	-0.279***	-0.421*
	(-9.727)	(-1.935)
$Size_{\ t-1}$	0.00465***	0.221***
	(4.568)	(13.62)
$Sales\ growth_{\ t-1}$	-0.0587***	0.132
	(-7.941)	(0.978)
$Turnover_{\ t-1}$	0.000268***	0.00430***
	(3.214)	(3.123)
$Return_{\ t-1}$	0.00461	-2.980***
	(0.0988)	(-4.092)
$Return\ sd_{\ t-1}$	-0.198***	2.721***
	(-5.615)	(4.878)
$Return\ skew_{\ t-1}$	-1.69e-05	-0.0398
	(-0.00983)	(-1.317)
$Capex_{\ t-1}$	-0.0863***	-0.129

	(-2.597)	(-0.192)
$R\&D_{t-1}$	0.134***	1.030**
	(4.697)	(2.136)
ROA_{t-1}	-0.0375*	-0.193
	(-1.851)	(-0.553)
$Leverage_{t-1}$	0.0501***	0.544***
	(6.907)	(4.599)
$Tangibility_{t-1}$	0.00714	-0.702***
	(1.030)	(-5.167)
$Free\ cash_{t-1}$	0.109***	0.773
	(4.253)	(1.579)
FPS_{t-1}	-0.00655**	0.109**
	(-2.345)	(2.202)
$Constant$	0.322***	-3.251***
	(8.033)	(-7.138)
Year dummies	Yes	Yes
Partial F-stat (2, 13375)	55.91	
dy/dx		-.0834***
		(-2.636)
R-squared\Pseudo R-squared	0.359	0.115
Observations	13,414	13,414

Table 1.5. The effect of monitoring cost and board independence on litigation risk – relations (4) and (5), each with two specifications

Panel A presents the results of probit regression of securities litigation on board independence and other covariates, including monitoring risks. In all specifications, the dependent variable is securities litigation, a dummy that equals 1 if a securities lawsuit filing against the firm occurs during the year, and 0 otherwise. In columns 1 and 2, firm-year observations are sorted into two groups, high and low monitoring costs groups (indicated as G in the table sub-heading). High monitoring is a dummy that equals 1 if firm-year observation belongs to the high monitoring cost group. Board ind * High monitoring is the interaction of board independence and high monitoring variable. Columns 3 and 4 are similar to columns 1 and 2 but with the second continuous measure of monitoring costs, i.e. MC index (indicated as C in the table sub-heading). Models in columns 1 and 3 include FPS and models in columns 2 and 4 include industry fixed effects. Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisk *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Panel B presents average marginal effects of board independence on probability of a securities lawsuit filing for firms with high monitoring cost (high monitoring = 1) and low monitoring cost (low monitoring=0). The term dy/dx indicates average marginal effects of board independence on probability of a securities lawsuit filing against a firm. The results in columns 1 and 2 are based on the same columns in Panel A.

Panel A: Estimates of relations (4) and (5)

Variables	**(1)**	**(2)**	**(3)**	**(4)**
	Monitoring cost-G	**Monitoring cost-G**	**Monitoring cost-C**	**Monitoring cost-C**
$Board\ independence_{t-1}$	-0.605***	-0.607***	-0.747**	-0.821***
	(-2.997)	(-2.919)	(-2.562)	(-2.888)
$Board\ ind * high\ monitoring_{t-1}$	0.456***	0.515***		
	(3.403)	(3.642)		
$High\ monitoring_{t-1}$	-0.365*	-0.297		
	(-1.881)	(-1.474)		
$Board\ ind * MC\ index_{t-1}$			0.789**	0.957**
			(1.980)	(2.328)
$MC\ index_{t-1}$			-0.613	-0.313
			(-1.611)	(-0.831)
$Board\ average\ age_{t-1}$	0.00100	0.00461	0.00113	0.00517
	(0.179)	(0.794)	(0.192)	(0.880)
$Board\ age\ diversification_{t-1}$	-0.000788	-0.00135	-0.000865	-0.00149
	(-0.272)	(-0.390)	(-0.284)	(-0.414)
$Board\ size_{t-1}$	0.0563	-0.00941	0.0503	-0.0142
	(0.517)	(-0.0849)	(0.429)	(-0.118)
$Duality_{t-1}$	0.0777*	0.0590	0.0777*	0.0577
	(1.868)	(1.370)	(1.788)	(1.305)
$Insider\ own_{t-1}$	-0.205	-0.157	-0.206	-0.155
	(-1.134)	(-0.953)	(-1.189)	(-1.023)

$Size_{t-1}$	0.216***	0.210***	0.217***	0.215***
	(13.59)	(12.10)	(11.93)	(11.96)
$Sales\ growth_{t-1}$	0.325**	0.339**	0.322**	0.330**
	(2.494)	(2.388)	(2.424)	(2.293)
$Turnover_{t-1}$	0.00388***	0.00545***	0.00391***	0.00517***
	(2.888)	(3.669)	(2.729)	(3.421)
$Return_{t-1}$	-3.793***	-3.616***	-3.781***	-3.524***
	(-4.943)	(-4.748)	(-4.871)	(-4.543)
$Return\ sd_{t-1}$	3.918***	3.589***	3.864***	3.012***
	(6.963)	(6.015)	(6.784)	(4.662)
$Return\ skew_{t-1}$	-0.0378	-0.0398	-0.0380	-0.0387
	(-1.308)	(-1.375)	(-1.353)	(-1.380)
$Capex_{t-1}$	0.0886	0.322	0.0826	0.306
	(0.142)	(0.497)	(0.113)	(0.409)
$R\&D_{t-1}$	1.035*	1.244**	1.052*	0.748
	(1.954)	(2.249)	(1.774)	(1.271)
ROA_{t-1}	-0.0457	-0.0679	-0.0533	-0.0678
	(-0.129)	(-0.184)	(-0.152)	(-0.186)
$Leverage_{t-1}$	0.481***	0.391***	0.475***	0.395***
	(4.159)	(2.908)	(3.502)	(2.730)
$Tangibility_{t-1}$	-0.681***	-0.805***	-0.676***	-0.778***
	(-5.158)	(-4.294)	(-4.263)	(-3.939)
$Free\ cash_{t-1}$	0.847*	0.797	0.840*	0.742
	(1.777)	(1.629)	(1.679)	(1.513)
FPS_{t-1}	0.0941*		0.0938*	
	(1.943)		(1.927)	
$Constant$	-3.934***	-3.494***	-3.819***	-3.509***
	(-8.812)	(-5.647)	(-7.629)	(-6.766)
Year Dummies	Yes	Yes	Yes	Yes
Industry Fixed Effect	No	Yes	No	Yes
Pseudo R-squared	.1006	.1332	.1011	.1336
Observations	14,844	14,844	14,844	14,844

Panel B: Marginal effects of board independence for firms with low and high monitoring cost under two alternative specifications

Groups	(1)	(2)
	dy/dx	dy/dx
Low monitoring	-.0550***	-.0496***
	(-2.96)	(-2.87)
High monitoring	-.0131	-.0086
	(-0.75)	(-0.45)

Table 1.6. The effect of firm complexity, total index, and board independence on litigation risk – relations (6), (7), and (8), each with two specifications

This table presents results of probit regression of securities litigation on Board independence and other covariates, including firm complexity and the overall total index. In all specifications, the dependent variable is securities litigation, a dummy that equals 1 if a securities lawsuit filing against the firm occurred during the year, and 0 otherwise. In columns 1 and 2, firm-year observations are sorted into two groups, high and low complexity groups (indicated as G in the table sub-heading), based on their complexity index. High complexity is a dummy variable that equals 1 if firm-year observation belongs to the high complexity group. Board ind * High complexity is the interaction of board independence and high complexity variable. Columns 3 and 4 are similar to columns 1 and 2 except that the continuous (indicated as C in the table) measure of firm complexity, i.e., COM index, is used. Board ind*COM index is the interaction of board independence and firm complexity index. In columns 5 and 6, TOTAL index is relative benefits and cost of board independence index and Board ind* TOTAL index is the interaction of board independence and Total index. Probit regression models in column 1, 3 and 5 include FPS whereas columns 2, 4 and 6 include industry fixed effects.

Panel B presents average marginal effects of board independence on probability of lawsuit filing for firms with high complexity (high complexity=1) and firms with low complexity (low complexity=0). The term dy/dx indicates average marginal effect of board independence on probability of a securities lawsuit filing against a firm. The results in columns 1 and 2 of this Panel are based on estimates in column 1 and 2 in Panel A, respectively.

Construction of the indices is explained in section 1.3. Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Panel A: Estimates of relations (6), (7), and (8)

Variables	(1) Firm complexity-G	(2) Firm complexity-G	(3) Firm complexity-C	(4) Firm complexity-C	(5) Total index	(6) Total index
$Board\ independence_{t-1}$	-0.172	-0.121	0.0380	0.0299	0.412	0.479
	(-0.857)	(-0.590)	(0.108)	(0.0874)	(0.992)	(1.220)
$Board\ ind * High\ complexity_{t-1}$	-0.400***	-0.442***				
	(-2.582)	(-2.75)				
$High\ complexity_{t-1}$	0.211	0.299				
	(1.088)	(1.522)				
$Board\ ind * COM\ indx_{t-1}$			-0.677*	-0.636*		
			(-1.843)	(-1.792)		
$COM\ index_{t-1}$			0.140	0.259		
			(0.332)	(0.656)		
$Board\ ind * total\ index_{t-1}$					-1.443**	-1.517**

					(-2.032)	(-2.286)
TOTAL index $_{t-1}$					0.469	0.623
					(0.851)	(1.247)
Board average age $_{t-1}$	0.00135	0.00403	0.00192	0.00416	0.00123	0.00430
	(0.240)	(0.693)	(0.328)	(0.709)	(0.210)	(0.727)
Board age diversificatio	-0.000975	-0.00134	-0.00184	-0.00173	-0.00175	-0.00270
	(-0.322)	(-0.358)	(-0.416)	(-0.370)	(-0.345)	(-0.362)
Board size $_{t-1}$	0.0813	0.0106	0.112	0.0266	0.0955	0.0250
	(0.750)	(0.0967)	(0.979)	(0.225)	(0.828)	(0.210)
Duality $_{t-1}$	0.0765*	0.0592	0.0797*	0.0622	0.0792*	0.0643
	(1.839)	(1.376)	(1.825)	(1.400)	(1.812)	(1.443)
Insider own $_{t-1}$	-0.195	-0.152	-0.203	-0.152	-0.202	-0.153
	(-1.071)	(-0.909)	(-1.148)	(-1.009)	(-1.154)	(-1.018)
Size $_{t-1}$	0.224***	0.213***	0.241***	0.229***	0.248***	0.243***
	(13.78)	(11.41)	(12.18)	(10.98)	(12.11)	(11.67)
Sales growth $_{t-1}$	0.312**	0.332**	0.287**	0.321**	0.299**	0.311**
	(2.387)	(2.342)	(2.154)	(2.239)	(2.253)	(2.173)
Turnover $_{t-1}$	0.00388***	0.00541***	0.00363**	0.00520***	0.00343**	0.00491***
	(2.899)	(3.645)	(2.541)	(3.442)	(2.405)	(3.252)
Return $_{t-1}$	-3.795***	-3.654***	-3.809***	-3.660***	-3.716***	-3.603***
	(-4.957)	(-4.803)	(-4.964)	(-4.763)	(-4.830)	(-4.690)
Return sd $_{t-1}$	3.690***	3.791***	3.658***	3.762***	3.197***	3.382***
	(7.049)	(7.007)	(7.056)	(7.071)	(5.774)	(5.995)
Return skew $_{t-1}$	-0.0384	-0.0428	-0.0386	-0.0425	-0.0375	-0.0415
	(-1.329)	(-1.481)	(-1.373)	(-1.514)	(-1.330)	(-1.474)
Capex $_{t-1}$	0.0685	0.261	0.0872	0.206	0.0645	0.188
	(0.111)	(0.404)	(0.123)	(0.281)	(0.0911)	(0.258)
R&D $_{t-1}$	1.094**	1.465***	1.340***	1.460***	0.664	1.121**
	(2.236)	(2.737)	(2.729)	(2.799)	(1.323)	(2.067)
ROA $_{t-1}$	-0.0462	-0.0322	-0.0300	-0.0202	-0.0343	-0.0185
	(-0.130)	(-0.0877)	(-0.0853)	(-0.0555)	(-0.0972)	(-0.0508)
Leverage $_{t-1}$	0.500***	0.409***	0.502***	0.407***	0.487***	0.405***
	(4.335)	(3.047)	(3.743)	(2.851)	(3.624)	(2.820)
Tangibility $_{t-1}$	-0.693***	-0.837***	-0.707***	-0.851***	-0.668***	-0.836***
	(-5.344)	(-4.489)	(-4.612)	(-4.300)	(-4.316)	(-4.230)
Free cash $_{t-1}$	0.929*	0.848*	1.002**	0.856*	0.878*	0.809*
	(1.953)	(1.742)	(2.025)	(1.751)	(1.786)	(1.657)
FPS $_{t-1}$	0.0909*		0.0859*		0.0833*	
	(1.872)		(1.740)		(1.694)	
Constant	-4.345***	-3.749***	-4.583***	-3.951***	-4.648***	-4.240***

	(-9.734)	(-6.113)	(-8.801)	(-7.594)	(-8.622)	(-7.879)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	No	Yes	No	Yes
Pseudo R-squared	.1011	.1336	0.1031	0.1329	.1026	.1345
Observations	14,844	14,844	14,844	14,844	14,844	14,844

Panel B: Marginal effects of board independence for firms with low and high complexity under two alternative specifications

Groups	(1)	(2)
	dy/dx	**dy/dx**
Low complexity	-.0167	-.0109
	(-0.86)	(-.59)
High complexity	-.0485***	-.0486***
	(-2.69)	(-2.63)

Table 1.7. Average marginal effects of board independence on securities litigation risk for different levels of monitoring costs, firm complexity, and total index

This table presents average marginal effects of board independence on probability of a securities lawsuit filing against a firm for different levels of MC Index, COM index and TOTAL index based on probit regression models in columns 4 (Table 1.5), and columns 4 and 6 (Table 1.6). The term dy/dx indicates average marginal effects of board independence on probability of a securities lawsuit filing against a firm for different levels of MC index, COM index, and TOTAL index in the above-cited columns, respectively. Construction of the indices is discussed in section 1.3. The Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

(1) Marginal costs dy/dx		(2) Firm complexity dy/dx		(3) Total index dy/dx	
0	-0.0547***	0	0.0032	0	0.0636
	(-2.71)		(0.09)		(1.18)
.1	-0.0514***	.1	-.0035	.1	0.0407
	(-2.79)		(-0.11)		(0.96)
.2	-0.0475***	.2	-.0097	.2	0.0204
	(-2.81)		(-0.38)		(0.62)
.3	-0.0428***	.3	-.0155	.3	0.0026
	(-2.73)		(-0.74)		(0.10)
.4	-0.0373**	.4	-.0210	.4	-.0130
	(-2.46)		(-1.19)		(-0.66)
.5	-0.0309**	.5	-.0262*	.5	-.0263
	(-2.00)		(-1.66)		(-1.59)
.6	-0.0236	.6	-.0309**	.6	-.0377**
	(-1.39)		(-2.02)		(-2.37)
.7	-0.0153	.7	-.0354**	.7	-.0472***
	(-0.78)		(-2.19)		(-2.78)
.8	-0.0059	.8	-.0395**	.8	-0.0552***
	(-0.25)		(-2.20)		(-2.89)
.9	0.0046	.9	-.0433**	.9	-0.062***
	(0.16)		(-2.14) **		(-2.86)
1	0.0163	1	-0.0468**	1	-.0667***
	(0.48)		(-2.05)		(-2.77)

Table 1.8. Monitoring cost and the effect of board independence on litigation risk -- segmented analysis

This table presents the results of probit regression of securities litigation on board independence and other covariates for firms with high and firms with low monitoring costs. In all specifications, the dependent variable is securities litigations. Firms are sorted into two groups (low and high) based on their monitoring costs. Columns 1 and 2 present results of probit regressions for firms with low monitoring cost without and with industry fixed effects, respectively. Column 3 and 4 present results of probit regressions for firms with high monitoring cost without and with industry fixed effects, respectively. The term dy/dx indicates average marginal effects of board independence on probability of a securities lawsuit filing against a firm. Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Variables	**(1) Low monitoring cost (wo)**	**(2) Low monitoring cost (w)**	**(3) High monitoring cost (wo)**	**(4) High monitoring cost (w)**
$Board\ independence_{t-1}$	-0.591**	-0.504**	-0.265	-0.286
	(-2.474)	(-2.049)	(-1.196)	(-1.252)
$Board\ average\ age_{t-1}$	0.00932	0.00878	-0.00484	0.00314
	(1.077)	(0.960)	(-0.652)	(0.395)
$Board\ age\ diversification_{t-1}$	-0.00485	-0.00327	0.0120	0.00349
	(-0.579)	(-0.562)	(1.014)	(0.280)
$Board\ size_{t-1}$	0.0551	-0.00573	0.0664	0.0844
	(0.356)	(-0.0361)	(0.431)	(0.527)
$Duality_{t-1}$	0.102	0.125*	0.0594	0.0237
	(1.595)	(1.835)	(1.067)	(0.413)
$Insider\ own_{t-1}$	-0.140	-0.0126	-0.229	-0.370
	(-0.588)	(-0.0776)	(-0.801)	(-1.190)
$Size_{t-1}$	0.240***	0.212***	0.220***	0.218***
	(10.16)	(7.704)	(10.03)	(9.419)
$Sales\ growth_{t-1}$	0.0704	0.161	0.553***	0.433**
	(0.357)	(0.716)	(3.098)	(2.336)
$Turnover_{t-1}$	0.00613**	0.00990***	0.00281*	0.00416**
	(2.477)	(2.929)	(1.752)	(2.437)
$Return_{t-1}$	-4.405***	-4.328***	-3.153***	-2.671***
	(-2.892)	(-2.821)	(-3.480)	(-2.963)
$Return\ sd_{t-1}$	3.533***	3.631***	2.922***	2.792***
	(3.438)	(3.329)	(4.538)	(4.166)
$Return\ skew_{t-1}$	-0.0507	-0.0384	-0.0332	-0.0357
	(-1.161)	(-0.858)	(-0.849)	(-0.908)
$Capex_{t-1}$	-0.699	-0.598	0.477	1.582*
	(-0.680)	(-0.526)	(0.608)	(1.866)

$R\&D_{t-1}$	-14.49***	0.444	-0.412	0.0628
	(-2.846)	(0.0658)	(-0.679)	(0.0998)
ROA_{t-1}	-0.428	-0.218	0.237	0.172
	(-0.650)	(-0.300)	(0.564)	(0.401)
$Leverage_{t-1}$	0.572***	0.612***	0.354**	0.129
	(3.398)	(2.810)	(2.106)	(0.699)
$Tangibility_{t-1}$	-0.658***	-0.341	-0.543**	-1.187***
	(-3.599)	(-1.225)	(-2.516)	(-4.155)
$Free\ cash_{t-1}$	2.014**	1.850**	0.0585	-0.0154
	(2.492)	(2.059)	(0.102)	(-0.0277)
FPS_{t-1}	-0.0610		0.138**	
	(-0.733)		(2.183)	
$Constant$	-4.877***	-5.256***	-3.718***	-3.578***
	(-6.911)	(-5.941)	(-6.467)	(-4.812)
Year Dummies	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	No	Yes
Pseudo R-squared	0.1232	0.1693	0.0968	0.1346
dy/dx	-.0420**	-0.0388**	-.0281	-.0297
	(-2.474)	(-2.049)	(-1.196)	(-1.252)
Observations	7,641	7,641	7,227	7,227

Table 1.9. Firm complexity and the effect of board independence on litigation risk -- segmented analysis

This table presents the results of probit regression of securities litigation on board independence and other covariates for firms with high and firms with low complexity. Firm-year observations are sorted into two groups based on their complexity index. Columns 1 and 2 present results of probit regressions for firms with low complexity without and with industry fixed effects, respectively. Columns 3 and 4 present similar results for firms with high complexity without and with industry fixed effects, respectively. The term dy/dx indicates average marginal effects of board independence on probability of a securities lawsuit filing against a firm. Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Variables	**(1) Low Complexity (wo)**	**(2) Low Complexity (w)**	**(3) High Complexity (wo)**	**(4) High Complexity (w)**
$Board\ independence_{t-1}$	-0.169	-0.0731	-0.550**	-0.561**
	(-0.664)	(-0.290)	(-2.342)	(-2.331)
$Board\ average\ age_{t-1}$	0.0104	0.00951	-0.00417	-0.00151
	(1.168)	(1.078)	(-0.522)	(-0.181)
$Board\ age\ diversification_{t-1}$	0.0172	0.0236*	-0.0164	-0.0227*
	(1.401)	(1.911)	(-1.316)	(-1.760)
$Board\ size_{t-1}$	0.0533	-0.0974	0.170	0.143
	(0.313)	(-0.604)	(1.104)	(0.840)
$Duality_{t-1}$	0.123*	0.119*	0.0393	0.0177
	(1.896)	(1.758)	(0.674)	(0.297)
$Insider\ own_{t-1}$	-0.140	-0.134	-0.330	-0.351
	(-0.622)	(-0.763)	(-1.260)	(-1.345)
$Size_{t-1}$	0.170***	0.165***	0.251***	0.239***
	(5.490)	(5.576)	(10.56)	(9.692)
$Sales\ growth_{t-1}$	0.391**	0.509**	0.233	0.221
	(2.157)	(2.410)	(1.215)	(1.130)
$Turnover_{t-1}$	0.00602***	0.00977***	0.00288	0.00275
	(3.112)	(4.452)	(1.433)	(1.282)
$Return_{t-1}$	-3.716***	-3.071***	-3.774***	-3.838***
	(-3.276)	(-2.662)	(-3.603)	(-3.568)
$Return\ sd_{t-1}$	2.642***	2.226**	4.630***	5.001***
	(3.383)	(2.546)	(6.693)	(7.137)
$Return\ skew_{t-1}$	-0.0347	-0.0381	-0.0474	-0.0487
	(-0.812)	(-0.863)	(-1.259)	(-1.316)
$Capex_{t-1}$	0.459	0.596	-1.275	-0.734
	(0.602)	(0.700)	(-1.085)	(-0.590)
$R\&D_{t-1}$	0.0655	-1.032	1.638**	2.831***
	(0.0854)	(-1.112)	(2.473)	(4.055)

ROA_{t-1}	-0.489	-0.420	0.186	0.197
	(-1.133)	(-0.928)	(0.347)	(0.343)
$Leverage_{t-1}$	0.679***	0.624***	0.324*	0.298
	(3.370)	(2.952)	(1.771)	(1.504)
$Tangibility_{t-1}$	-0.630***	-0.534**	-0.734***	-1.087***
	(-3.250)	(-1.999)	(-3.102)	(-3.530)
$Free\ cash_{t-1}$	1.026*	0.418	0.803	1.043
	(1.751)	(0.674)	(1.030)	(1.336)
FPS_{t-1}	0.0672		0.0840	
	(0.911)		(1.311)	
Constant	-4.691***	-3.704***	-3.975***	-3.425***
	(-5.978)	(-4.454)	(-6.455)	(-5.123)
Year Dummies	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	No	Yes
Pseudo R-squared	0.1021	0.1542	0.1135	0.1410
dy/dx	-.0129	-.0056	-.5336**	-0.542**
	(-0.664)	(-0.290)	(-2.342)	(-2.331)
Observations	7, 745	7,745	7,223	7,223

Table 1.10. Monitoring cost, firm complexity, and effect of board independence on litigation risk -- IV approach under segmented data

This table presents the results of the second stage of IV probit regressions, where the dependent variable is securities litigations, a dummy that equals 1 if a securities lawsuit filing against the firm occurs during the year, and 0 otherwise. In the first stage, board independence is regressed on two instrumental variables, county ratio and industry ratio, and other covariates. The predicted values of board independence from the first stage regression are used in the second stage. Firm-year observations are sorted into two groups based on their monitoring costs (firms with low and firms with high monitoring costs). Columns 1 and 2 present the results of the second stage of the IV probit model for high and low monitoring cost firms, respectively. Columns 3 and 4 present the results of the second stage of the IV probit model for firms with low and firms with high complexity, respectively. The term dy/dx indicates average marginal effects of the predicted board independence on probability of a securities lawsuit filing against a firm. Variables are defined in Appendix A. The t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. The asterisks *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Variables	(1) Low monitoring cost	(2) High monitoring cost	(3) Low complexity	(4) High complexity
$Predicted\ Board\ independence_{t-1}$	-1.934***	-0.129	-0.227	-1.977***
	(-3.128)	(-0.210)	(-0.346)	(-3.347)
$Board\ average\ age_{t-1}$	0.0135	-0.00477	0.00669	-0.00180
	(1.485)	(-0.630)	(0.798)	(-0.219)
$Board\ age\ diversification_{t-1}$	-0.00900	0.0121	0.0142	-0.0184
	(-0.730)	(0.898)	(1.011)	(-1.421)
$Board\ size_{t-1}$	0.0105	-0.0394	-0.00495	0.133
	(0.0662)	(-0.247)	(-0.0300)	(0.885)
$Duality_{t-1}$	0.0862	0.0561	0.121**	0.0389
	(1.425)	(1.030)	(1.968)	(0.725)
$Insider\ own_{t-1}$	-0.468*	-0.241	-0.134	-0.820**
	(-1.747)	(-0.659)	(-0.494)	(-2.470)
$Size_{t-1}$	-0.0500	0.165**	0.0700	0.0904
	(-0.582)	(2.525)	(0.913)	(1.329)
$sales\ growth_{t-1}$	0.255***	0.222***	0.181***	0.255***
	(10.41)	(9.884)	(6.764)	(11.70)
$Turnover_{t-1}$	-0.177	0.387**	0.255	0.0181
	(-0.846)	(2.167)	(1.276)	(0.101)
$Return_{t-1}$	0.00535**	0.00329*	0.00507**	0.00446**
	(2.178)	(1.956)	(2.484)	(2.319)
$Return\ sd_{t-1}$	-3.188**	-2.287***	-2.630**	-3.177***
	(-2.358)	(-2.643)	(-2.565)	(-3.071)
$return\ skew_{t-1}$	2.590**	2.205***	1.933**	3.226***
	(2.528)	(3.087)	(2.387)	(4.117)

$Capex_{t-1}$	-0.0639	-0.0271	-0.0354	-0.0462
	(-1.411)	(-0.660)	(-0.761)	(-1.168)
$R\&D_{t-1}$	-1.218	0.367	0.423	-1.863
	(-1.062)	(0.448)	(0.611)	(-1.561)
ROA_{t-1}	-10.20*	-0.425	0.192	1.800***
	(-1.928)	(-0.702)	(0.254)	(2.731)
$Leverage_{t-1}$	-0.678	0.101	-0.709	0.249
	(-1.055)	(0.250)	(-1.539)	(0.479)
$Tangibility_{t-1}$	0.632***	0.376**	0.619***	0.521***
	(3.808)	(2.161)	(3.553)	(3.153)
$Free\ cash_{t-1}$	-0.599***	-0.614***	-0.689***	-0.627***
	(-3.035)	(-2.846)	(-3.937)	(-3.019)
FPS_{t-1}	2.350***	-0.133	1.056*	0.577
	(2.873)	(-0.227)	(1.743)	(0.746)
$Constant$	-3.663***	-3.271***	-3.894***	-2.761***
	(-4.938)	(-5.161)	(-5.097)	(-4.112)
Year Dummies	Yes	Yes	Yes	Yes
Pseudo R-squared	0.1190	0.1096	0.1112	0.1109
dy/dx	-0.1550***	-.01406	-.0182	-.2070***
	(-2.897)	(-0.21)	(-0.35)	(-3.543)
Observations	6,882	6,532	6,896	6,545

CHAPTER 2: SECURITIES LITIGATION RISK AND BOARD GENDER DIVERSITY

2.1 Introduction

A firm that endures securities litigation bears substantial expenses, mostly in the form of settlement costs.[12] These litigation costs might have a negative impact on liquidity, investment policies, external financing policy, credit worthiness, and payout policy of a firm (e.g., Autore et al., 2014; Arena and Julio, 2015; Arena and Julio, 2016; Arena, 2018). In addition, there are hidden costs of contracts, damage to the firm's image, and harm to the firm's relations with suppliers and customers (Engelmann and Cornell, 1988; Lawry and Shu, 2002). Considering the substantial costs of securities litigation risk, it is imperative that shareholders take steps to alleviate this risk. Shareholders may reduce securities litigation risk by effective monitoring of management which depends on the composition of board of directors. We consider one aspect of board composition, board gender diversity, and examine its effect on corporate securities litigation risk. We find that the presence of female independent directors on company boards reduces corporate securities litigation risk. Our analysis also shows that monitoring cost has a negative effect, and complexity of firm has a positive influence on the effectiveness of female independent directors in moderating securities litigation risk. Further analysis reveals that female

[12] According to the Audit Analytics database, publicly traded companies have paid an average of $223 million in settlement, but for some companies these costs are in billions of dollars and lead to their bankruptcy. Enron had to pay $7.1 billion in settlement whereas WorldCom had a settlement cost of $6.1 billion.

independent directors enhance board participation and increase the firm's conditional accounting conservatism, thus improving monitoring function of a firm's board.[13]

Our argument to link the presence of female independent directors on a corporate board to a firm's securities litigation risk is based on theoretical evidence that higher monitoring of management aligns their interests to shareholders' and empirical evidence that female directors are tougher monitors. Agency theory by Jensen and Meckling (1976) states that the separation of ownership and management may lead to interest conflicts between management and shareholders. A company's board plays a crucial role in alleviating such interest conflicts by plying a liaison role between shareholders and management. As a representative of shareholders, the company board monitors the functioning of management, apprises the shareholders of management decisions in a timely manner, and stops the management from making decisions that affect the shareholders adversely. To increase the monitoring effectiveness of the board of directors, it is important to align directors' interests with shareholders'. One avenue to achieve this alignment is to exploit the reputational concern of independent directors (Fama, 1980; Fama and Jensen, 1983). As future careers of independent directors depend on their performance in the directorship they serve, there is an incentive for independent directors to execute their monitoring role effectively.

Since there is a glass ceiling phenomenon and women face more barriers to enter corporate boards, female independent directors might have more reputational concerns

[13] Conditional accounting conservatism is the reflection of bad news on firms' earning reports quicker than good news.

compared to their male counterparts, and their performance might be under tougher scrutiny (Lee and James, 2007; Lara et al., 2017). Therefore, female independent directors have more incentive to be active monitors. Moreover, since female independent directors do not belong to the "Old Boys' Club", in theory, they might be more relevant to the concept of board independence (Carter et al., 2003; Adams and Ferreira, 2009). Adams and Ferreira (2009) provide empirical evidence that female independent directors enhance monitoring function of a board. They find that female independent directors have less attendance problems than their male counterparts and they are more likely to join monitoring committees. Lara et al. (2017) show that there is a significant negative relationship between proportion of female independent directors and earning management practices suggesting improved monitoring in firms with female independent directors. Overall, there is agreement amongst researchers that inclusion of female independent directors on a firm board improves the monitoring function of the board. Since female independent directors provide better monitoring and better monitoring helps align management's interests with shareholders, we argue that presence of female independent directors on a board would curtail litigation risk. We posit our first hypothesis:

Hypothesis 1: The higher the fraction of female independent directors on a company board the lower the securities litigation risk.

To study the impact of female independent directors on firms' securities litigation risk, we use litigation data for S&P 1500 firms over the period of 1998 to 2017.[14] We find

[14] Our sample of companies and the period is driven by the limitations of the Institutional Shareholders Services (ISS) data for directors, which is available for S&P 1500 firms starting from 1996. Since we lag the gender diversity variables up to two years, the period for litigation data starts from 1998.

that the presence of female independent directors on a firm's board reduces the corporate securities litigation risk, while female non-independent directors have no impact on securities litigation risk.[15] Since female independent directors might self-select to serve on boards of firms that have better reputations and potentially lower litigation risk, endogeneity is a possible concern. We address endogeneity concerns by using various econometric methods: conditional fixed effects logit model, linear probability model (LPM) with firm fixed effects, two-stage instrumental variables (IV) probit model, Heckman correction model, and propensity score matching methodology. Our empirical tests consistently indicate that as the fraction of female independent directors on a board increases, the probability of a security lawsuit against the firm decreases.

Next, we examine if a firm's monitoring costs influence the effectiveness of female independent directors in moderating the securities litigation risk. Demsetz and Lehn (1985) suggest that monitoring costs are higher for firms operating in unstable environments that have volatile prices, changing technology, and fluctuating market shares requiring managers to make frequent decisions about reallocation of firm's assets and resources. They argue that in such unstable environments, effects of managerial decisions on firm performance are compounded by effects of other, volatile exogenous factors, making it difficult and costly to monitor managerial behavior. Therefore, the higher the instability of a firm's operational environment, the less effective it is to impose intense monitoring on the firm's management. Several studies have shown that firms with higher monitoring costs have lower degrees of outside monitoring (e.g., Gillan et al., 2003; Coles et al., 2008) and

[15] Female independent directors are non-executive female directors who do not have any affiliation with the firm they work for.

imposing a high level of outside monitoring on the management of these firms has a negative impact on the performance (e.g., Wintoki, 2007; Balsam et al., 2016). As the effectiveness of monitoring is adversely related to monitoring costs, we argue that female independent directors would have less influence in curtailing litigation risk for firms with high monitoring costs. Based on above arguments, we propose our second hypothesis:

Hypothesis 2: The effectiveness of female independent directors in moderating securities litigation risk is negatively related to a firm's monitoring costs.

Similar to other researchers in this field (e.g., Gillan et al., 2003; Wintoki, 2007; Coles et al., 2008; Balsam et al., 2016), we use the standard deviation of returns, R&D expenditures and asset intangibility as proxies for the monitoring costs. Our findings indicate that the effectiveness of female independent directors in moderating the litigation risk substantially decreases with the increase in firms monitoring costs.

Further, we investigate if the complexity of a firm influences the effectiveness of female independent directors in reducing securities litigation risk. As a firm expands its operational scope and becomes more complex, agency costs increase. Therefore, imposing intense monitoring on managers plays a vital role to mitigate agency problems. Several studies find that firms with higher complexity impose higher degrees of outside monitoring on managers (e.g., Chhaochharia and Grinstein, 2007; Boone et al., 2007; Coles et al., 2008; Balsam et al., 2016). Moreover, researchers have shown that intense monitoring on managers adds value to more complex firms (Crutchley et al., 2004; Wintoki, 2007; Lehn et al., 2009; Balsam et al., 2016). Since female independent directors can provide better monitoring, they should be more effective in lowering the litigation risk for complex firms.

Conversely, in firms with lower complexity, there are less agency problems, making monitoring role of women independent directors less effective. We posit our third hypothesis as:

Hypothesis 3: The effectiveness of female independent directors in moderating securities litigation risk is positively related to the complexity of firm.

Following the existing literature (e.g., Lehn et al., 2009; Anderson et al., 2011; Balsam et al., 2016), we use market capitalization, number of business segments, number of employees, age, and internationalization factor as proxies for firm complexity.[16] Our results indicate that the effectiveness of female independent directors in reducing litigation risk is higher in firms with higher levels of complexity.

We address the endogeneity concerns involved in the impact of monitoring costs and firm complexity on the effectiveness of female independent directors, by applying two-stage IV probit model. Our results confirm the findings that the effectiveness of female independent directors in reducing litigation risk increases with decrease in firm's monitoring costs and increase in firm's complexity.

Finally, we explore the potential channels through which board gender diversity may reduce litigation risk. One channel through which female independent directors may reduce litigation risk is the improvement in board participation. Higher board participation may increase the monitoring effectiveness of a board, thereby reducing the litigation risk. Adams and Ferreira (2008) state that one of the key responsibilities of directors is to attend board meetings since it is the main mechanism for them to collect information and monitor

[16] Internationalization factor measures if a firm has income overseas.

management. Collecting data on what goes on in the boardroom is almost impossible since corporations do not usually disclose information about minutes of meetings and voting outcomes (Ferreira, 2010). Therefore, measuring the contribution of each director to the decision-making process and monitoring is not feasible. The only exception in this regard is the measurement of board members' attendance since the U.S. Securities and Exchange Commission (SEC) mandates U.S. public firms to reveal the names of directors who attend less than 75 percent of the annual meetings. Using the director level attendance data, we find the directors and the firms that have board attendance problems i.e. the directors that attend less than 75 percent of board meetings and the firms they are in. We investigate if the presence of female independent directors influence board participation and find that inclusion of female independent directors on boards reduces board attendance problems. Similar to Adams and Ferreira (2009), we find that the more gender-diverse the board is the fewer director attendance problems there are.

Another channel through which gender diverse boards may reduce litigation risk is conditional accounting conservatism. Under conditional conservatism, or asymmetric timeliness of earnings, firms reflect bad news in their earnings reports more quickly than good news (Basu, 1997). Conditional conservatism reduces the potential agency problems between shareholders and managers by timely recognition of losses in financial statements (e.g., Ball, 2001; Srivastava et al., 2015; and Basu and Liang, 2019), thereby lowering the likelihood of overvaluation of stocks and the subsequent potential dramatic fall of stock price. Therefore, conditional conservativeness reduces the likelihood of a securities lawsuit against a firm by making it more challenging for the shareholders to prove that they incurred financial losses through sharp stock price crashes (Ettredge et al., 2016). We follow Basu and Liang (2019) methodology to measure conditional accounting conservatism and investigate the influence of female independent directors on it. Our empirical tests reveal that firms with higher proportions of female independent directors on their boards exhibit higher conditional accounting conservativeness.

We make several contributions to the literature, and our findings provide important guidelines for policy makers and legislatures. First, we provide empirical evidence relating board gender diversity to corporate securities litigation risk.[17] To our knowledge, only Talley's (2009) work is somewhat related to our study. Using a panel dataset of public companies from 2001 to 2005, Talley (2009) explores whether a firm's structural governance choices predict its later susceptibility to securities class action litigation. He finds that governance factors (including board independence, separation of CEO and board chair positions, and percentage of female directors on a board) have negligible predictive value, both statistically and economically. These results that run counter to ours could be due to the small sample size (only 2001-2005) as compared to ours (1998-2017) and shortfall in the methodology employed. Talley (2009) ignored the inclusion of industry fixed effects in the regressions, which may make his results biased, as litigation risk is sensitive to industry classification. Second, we find that inclusion of female independent directors might not be helpful in reducing securities litigation risk for some firms. While firms with higher complexity and lower costs of intense monitoring can remarkably benefit from higher representation of female independent directors on their boards, inclusion of

[17] In the context of non-security litigation risks, Liu (2018) finds that board gender diversity lowers the number of environmental lawsuits. Adhikari et al. (2019) find that firms in which women executives have more power face fewer operation-related lawsuits.

female independent directors in less complex firms and firms with higher monitoring costs might be ineffective in curtailing securities litigation risk. The differing effectiveness of female independent directors for different types of firms has policy implications as it suggests that governance requirements should not be uniform across firms.

The reminder of this paper is organized as follows. In Section 2.2, we describe the details of the data used. We explain the methodology in Section 2.3. In Section 2.4, we present the empirical results of testing the effect of inclusion of female independent directors on securities litigation risk. Channels through which female independent directors may influence litigation risk are in Section 2.5. We provide our conclusion in Section 2.6.

2.2 Data

Our study covers S&P 1500 companies for the time period of 1998 to 2017. As is customary in this field of research, we exclude financial service companies (SIC codes from 4900 to 4999) and utility firms (SIC codes from 6000 to 69999). We use five data sources in our study: Audit Analytics Litigation Database, Institutional Shareholder Service Directors, Compustat, Center for Research in Security Prices, and Execucomp. We obtain data for securities lawsuits from Audit Analytics-Legal Case and Legal Parties, which provides case data on material civil litigation filed in federal district courts for public registrants under SEC regulation S-K §229.103. In our study, we use only securities lawsuit cases that are indicated by security type 41 in the Audit Analytic Database. Securities lawsuits are based on a misleading action in violation of securities laws that deceive investors to trade based on false information, frequently resulting in losses. Securities frauds include a wide range of actions, including stock manipulation, financial misreporting, lying to corporate auditors, insider trading, front running, etc.

We use Institutional Shareholders Service Directors (formerly RiskMetrics) data related to individual board directors on universe of S&P 1500 companies. We obtain accounting data, market return information, and executive related information from Compustat, CRSP, and Execucomp, respectively.

2.3 Methodology

2.3.1 Base models

Kim and Skinner (2012) propose the following probit regression model to study the determinants of corporate litigation risk:

$$Security\ lit_t = \beta_0 + \beta_1 (FPS_{t-1}) + \beta_2 (Size_{t-1}) + \beta_3 (Sales\ growth_{t-1}) + B_4(Return_{t-1}) + \beta_5 (Return\ sd_{t-1}) + \beta_6 (Return\ skew_{t-1}) + \beta_7 (Turnover_{t-1}) + Y_t + \varepsilon_{i,t} \quad (1)$$

Where the dependent variable, $Security\ lit_t$, is a binary variable that equals one if a securities lawsuit is filed against a firm in year t. Francis et al. (1994) suggest that firms in biotech, computer, electronics, and retail industries have higher litigation risks compared to other industries. To control for these industries, Kim and Skinner (2012) include a dummy variable, *FPS*, which is set to one if the firm is in any one of these four industries. Y_t represents year fixed effect. Detailed definitions of the other variables are in Appendix A.

To measure the effect of board gender diversity on corporate securities litigation risk, we expand Kim and Skinner's (2012) model and add variables related to gender diversity on a board. In addition, to address potential misspecification, we improve their model by controlling for additional board characteristics, CEO attributes, and firm-level controls. Moreover, we include industry fixed effects based on a two-digit SIC code in lieu of *FPS* dummy variable.[18] We use the following probit model:[19]

$$Security\ lit_{i,t} = \beta_0 + \beta_1(Female\ ind\ ratio_{i,t-1}) + \beta_2(Female\ non-ind\ \ ratio_{i,t-1}) + \theta\boldsymbol{X}_{i,t-1} + I_j + Y_t + \varepsilon_{i,t} \qquad (2)$$

Our variables of interest are *Female ind ratio* (ratio of female independent directors to the total number of directors at the end of year t-1) and *Female non-ind ratio* (ratio of female non-independent directors to the total number of directors at the end of year t-1) to capture the gender diversity on a board. Vector ***X*** embodies a series of additional controls including size, sales growth, stock turnover (Turnover), return, return volatility (Return sd), return skewness (Return skew), R&D intensity, free cash flow, leverage, capital expenditures (Capex), asset tangibility (Tangibility), Market-to-book ratio, return on assets (ROA), the proportion of male independent directors on a board (Male ind ratio), female CEO, female CFO, CEO tenure, CEO turnover, board size, CEO duality, board's average age, and board's age diversification. Following Kim and Skinner (2012) and Liu (2018), all explanatory variables are lagged by one year to address the potential endogeneity. In further robustness tests, we lag the key explanatory variable, *Female ind ratio*, by two years. I_j represents industry fixed effects based on a SIC two-digit code. Detailed definitions of variables are in Appendix A.

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[18] Our results stay the same even when we include FPS in our regressions.

[19] Our results stay the same when we use a logit model instead of a probit model.

In addition, to address the unobserved heterogeneity, self-selection, and omitted-variable bias, we employ the conditional fixed effects logit model proposed by Chamberlain (1980). To mitigate the potential bias caused by non-observed heterogeneity, we provide results using Linear Probability Model (LPM) with the inclusion of the firm fixed effects.

2.3.1.1 Two-stage IV Probit model

In assessing the effect of board gender diversity on litigation risk, there is a potential for endogeneity. Since female independent directors might be concerned more about their reputation, it is likely that they avoid joining firms that have higher litigation risk. To deal with the potential reverse causality, we use a two-stage instrumental variable probit model. We instrument *Female ind ratio* by two variables. Adams and Ferreira (2009) suggest the first instrument, *Male connection*. *Male connection* is the ratio of male directors who sit on other boards with at least one female director to the total number of male directors. This is a suitable instrument since the connection of male directors to women directors on other boards can increase the visibility of female directors as potential candidates for director appointments on additional company boards. Therefore, the greater the connection of male directors to women directors, the greater the proportion of female independent directors on boards should be. However, it is unlikely that *Male connection* directly affects the litigation risk of a firm. The second instrument, *County female ratio*, is the proportion of the total number of female directors in the county where a firm is headquartered to the total number of directors in that county, excluding the sample firm. This instrument also appears to be suitable because the proportion of female directors on local peers' boards is unlikely to affect the litigation risk of a firm directly. But, a higher supply of female directors in the county may be positively correlated with the proportion of female independent directors in the firm (Glaeser and Scheinkman, 2003 John and Kadyrzhanova, 2010; Anderson et al., 2011; Puthenpurackal and Upadhyay, 2013).

In the first stage, we regress *Female ind ratio* on these two instruments and other covariates [relation (3)]. In the second stage, we include the predicted value of *Female ind ratio* from the first stage in a probit regression model [relation (4)].

$$Female\ ind\ ratio_{i,t} = \beta_0 + \beta_1(Male\ connection_{i,t}) + \beta_2(County\ female\ ratio_{i,t}) + \theta \boldsymbol{X}_{i,t} + I_j + Y_t + \mu_{i,t} \quad (3)$$

$$Security\ lit_{i,t} = \beta_0 + \beta_1(\widehat{Female\ ind\ ratio}_{t-1}) + \theta \boldsymbol{X}_{i,t-1} + I_j + Y_t + \varepsilon_{i,t} \quad (4)$$

2.3.2 Alternative models

As a further check, we use the number of female independent directors on a board to capture the gender diversity of the corporate board. We use the model of Liu (2018) with some minor modifications. In Liu (2018), the dependent variable is a dummy that equals one if an environmental lawsuit is filed against the firm. Our dependent variable is a dummy that equals one if a securities lawsuit is filed against the firm. Liu (2018) uses the number of female directors while our focus is on the number of female independent directors. We employ the following probit model:

$$Security\ lit_{i,t} = \beta_0 + \beta_1(Female\ ind\ 1_{i,t-1}) + \beta_2(Female\ ind\ 2_{i,t-1}) + \beta_3(Female\ ind \geqslant 3_{i,t-1}) + \beta_4(Female\ non-ind_{i,t-1}) + \theta \boldsymbol{X}_{i,t-1} + I_j + Y_t + \varepsilon_{i,t} \quad (5)$$

Where, *Female ind* 1 is a binary variable that equals to one if a firm has exactly one female independent director. *Female ind 2* is a binary variable that equals to one if a firm has exactly two female independent directors. *Female ind ⩾ 3* is a binary variable that equals to one if a firm has three or more female independent directors. *Female non-ind* is a binary variable that equals to one if a firm has one or more non-independent female directors. To alleviate possible endogeneity concerns, we provide additional tests by lagging key explanatory variables, *Female ind 1*, *Female ind 2* and *Female ind ⩾3*, by two years. In addition, to address the unobserved heterogeneity and omitted-variable bias, we also employ the conditional fixed effects logit model and LPM with the inclusion of the firm fixed effects.

2.3.2.1 Heckman's selection model

As we discussed earlier, it is possible that reputation-concerned female independent directors self-select to join boards of firms with lower potential litigation risk. We use Heckman's two-step approach (Heckman, 1979) to correct for this potential self-selection bias on the subsample of firms that have exactly one female independent director and those that do not have any female independent directors. In the first step, we run the following probit model:

$$Female\ ind\ 1_{i,t} = \beta_0 + \beta_1(Male\ connection_{i,t}) + \beta_2(county\ female\ ratio_{i,t}) + \theta \boldsymbol{X}_{i,t} + I_j + Y_t + \mu_{i,t} \quad (6)$$

Then, we calculate the inverse mills ratio from the first step probit regression and include it in the second step probit regression:

$$Security\ lit_{i,t} = \beta_0 + \beta_1(Female\ ind\ 1_{i,t-1}) + \beta_2(inversemills\ ratio_{i,t-1}) + \theta \boldsymbol{X}_{i,t-1} + I_j + Y_t + \varepsilon_{i,t} \quad (7)$$

In the next test, we keep firms that have exactly two female independent directors and those that do not have any female independent directors, i.e. we replace *Female ind 1* by *Female ind 2* in relations (6) and (7). In further tests, we keep firms that have three or more female directors and those that do not have any female independent directors, i.e. we replace *Female ind 1* by *Female ind ⩾3* in relations (6) and (7).

2.3.2.2 Propensity score-matched samples

To address potential concerns of endogeneity and self-selection bias, we employ a propensity score matching procedure to reduce any unobserved heterogeneities that might concurrently affect board gender diversity and securities litigation risk. We pair-match firm-year observations that have exactly one female independent director with firm-year observations that do not have any female independent directors. We do the matching by industry (two-digit SIC), size, sales growth, turnover, return, return standard deviation, return skew, Male ind ratio, board size, duality, board's average age, board's age diversification, R&D intensity, cash flow, leverage, capital expenditures, tangibility, market-to-book ratio, and ROA within each year.[20] We estimate the following probit regression using the propensity score-matched sample:

$$Security\ lit_{i,t} = \beta_0 + \beta_1(Female\ ind\ 1_{i,t-1}) + \theta \mathbf{X}_{I,t-1} + I_j + Y_t + \varepsilon_{i,t} \quad (8)$$

Similarly, we pair-match firm-year observations that have exactly two female independent directors with firm-year observations that do not have any female independent directors. Then, we replace *Female ind 1* by *Female ind 2* in relation (8) and re-run it by

[20] We employ one-to-one nearest neighborhood matching.

using the propensity score-matched sample. Finally, we pair-match firm-year observations that have three or more female independent directors with firm-year observations that do not have any female independent directors. Then, we replace *Female ind 1* with *Female ind ⩾3* in relation (8) and estimate it using the propensity score-matched sample.

2.3.3 Models for measuring the effect of monitoring cost and firm complexity

In order to investigate if the influence of female independent directors depends on monitoring cost and firm complexity, we construct a monitoring cost index (*MC index*) and a complexity index (*COM index*). Our approach to construct these indexes is similar to Wintoki (2007).

We form the *MC index* using the standard deviation of the firms' 12-month return (*Return sd*), R&D intensity (*R&D*), and asset intangibility (*Asset int*). Along each variable, we sort the firm-year observations into deciles in an ascending order. Next, we assign them a score of 1 to 10 based on the rank of their deciles. To construct the *MC index*, we sum the scores across the three dimensions (*Return sd*, *R&D* and *Asset int*). We then normalize this index by scaling it between 0 and 1.

We use a similar method and form the complexity index using five dimensions: Market capitalization, number of business segments, number of employees, firm age, and having a foreign business segment.[21]

To measure the impact of *MC index* and *Com index* on the effect of female independent directors on the litigation risk, we include these indexes and their interaction

[21] We assign a score of 10 to firms that have a business segment overseas.

with *Female ind ratio* in relation (2). Therefore, we estimate the following probit models [relation (9) and (10)]:

$$Security\ lit_{i,t} = \beta_0 + \beta_1(Female\ ind\ ratio_{i,t-1}) + \beta_2(MC\ index_{i,t-1}) + \beta_3(Female\ ind\ ratio * MC\ index_{i,t-1}) + \theta \mathbf{X}_{I,t-1} + I_j + Y_t + \varepsilon_{i,t} \quad (9)$$

$$Security\ lit_{i,t} = \beta_0 + \beta_1(Female\ ind\ ratio_{i,t-1}) + \beta_2(COM\ index_{i,t-1}) + \beta_3(Female\ ind\ ratio * COM\ index_{i,t-1}) + \theta \mathbf{X}_{i,t-1} + I_j + Y_t + \varepsilon_{i,t} \quad (10)$$

Where, *Female ind ratio*MC index* in relation (9) is the interaction of *Female ind ratio* and *MC index.* The term *Female ind ratio*COM index* in relation (10) denotes the interaction of *Female ind ratio* and *COM index.*

The estimate of β_3 in relation (9) captures the impact of a firm's monitoring cost on the effects of female independent directors on the litigation risk. The estimate of β_3 in relation (10) reflects as the impact of a firm's complexity on the effects of female independent directors on the litigation risk.

2.4 Empirical Results

2.4.1 Summary statistics of the variables

Table 2.1 summarizes descriptive statistics of all the variables.[22] The average of *Female ind ratio* is 0.099 indicating that, on average, 9.9 percent of directors of firm-year observations in our sample are female independent directors. The average of *Female non-*

[22] To reduce the influence of outliers, we winsorize all non-binary variables at 1st and 99th percentiles.

ind ratio is 0.006 indicating that, on average, 0.6 percent of directors of firm-year observations in our sample are female non-independent directors. 35.5 percent of firm-year observations in our sample have exactly one female independent director. 19.2 percent of firm-year observations have exactly two female independent directors, and 6.5 percent of observations have three or more female independent directors. 5.6 percent of firm-year observations have at least one non-independent female director. Table 2.1 also shows that 4.4 percent of firm-year observations in our sample are involved in security litigations.

< Insert Table 2.1 here >

Table 2.2 provides the number and percentage of firm-year litigations in our sample by industry. Firms operating in educational services, agricultural production (crops), communications, and health services have the highest rate of securities litigation in our sample.

< Insert Table 2.2 here>

In Figure 2.1, we present the percentage of firms involved in material securities litigation for each year in our sample. The percentage of litigated firms has increased noticeably in recent years. There is a dramatic upward trend in litigation from 2015 to 2017 when the average percentage of firms involved in litigation increases from 3% to around 8%. A series of Delaware court decisions that signaled the state's courts' hostility to disclosure-only settlements in merger objection cases accounts for this sharp increase.[23] These decisions encourage plaintiffs to shift merger objection cases away from Delaware courts to federal court. However, merger objection cases are not the only reason for the

[23]For example, in the Trulia case, the Delaware Chancery Court did not approve the disclosure-only settlement of a lawsuit objecting the disclosures associated to Zillow's acquisition of Trulia.

recent increase in the percentage of litigated firms. Even if we ignore the merger objection cases in recent years, the percentage of involved firms is above the prior average annual rate from 1996 to 2015.

< Insert Figure 2.1 here >

2.4.2 Female independent directors and securities litigation risk

In our first hypothesis, we investigate if a higher fraction of female independent directors on a company board is associated with lower securities litigation risk. In Table 2.3, we provide empirical results for the test of hypothesis and estimate all six variants of relation (2) discussed in section 2.3.1. The first two variants are under a probit modeling procedure while the third and the fourth variants are under a fixed effects conditional logistic modeling. The fifth and the sixth variants are LPM that include firm fixed effects.

Column 1 and Column 2 of Table 2.3 report the results of probit models using *Female ind ratio* as the key explanatory variable, lagged by one and two years, respectively. Results indicate that the coefficients of $Female\ ind\ ratio_{t-1}$ and $Female\ ind\ ratio_{t-2}$ are negative and statistically significant at the 1 percent level. The marginal effects of $Female\ ind\ ratio_{t-1}$ and $Female\ ind\ ratio_{t-2}$ on the probability of filing a securities lawsuit against a firm (i.e., dy/dx) are -0.087 and -0.081, respectively. Both are statistically significant at the 1 percent level. The marginal effects of $Male\ ind\ ratio_{t-1}$ and $Male\ ind\ ratio_{t-2}$ on the probability of a lawsuit filing against a firm are -0.031 and -0.025, statistically significant at the 5 percent level and the 10 percent level, respectively. These results show that the magnitude of the negative marginal effect of the fraction of female independent directors on the probability of a securities lawsuit is around three times higher than the magnitude of the marginal effect of the fraction of male independent directors on the board.

To mitigate the unobserved heterogeneity and omitted-variable bias, we apply the conditional fixed effects logit model proposed by Chamberlain (1980) and report our results in Columns 3 and 4 of Table 2.3. We include firm fixed effects in the models. The coefficients of $Female\ ind\ ratio_{t-1}$ and $Female\ ind\ ratio_{t-2}$ are negative and statistically significant at the 1 percent level. Finally, Columns 5 and 6 of Table 2.3 display the results of the LPM with the inclusion of the firm fixed effects. The average marginal effects of $Female\ ind\ ratio_{t-1}$ and $Female\ ind\ ratio_{t-2}$ on the probability of filing a securities lawsuit against a firm are -0.14 and -0.13, respectively. Both are statistically significant at the 1 percent level. In both the conditional fixed effects and LPM models, we find the coefficient for *Male ind ratio* to be statistically insignificant. Overall, the results of Table 2.3 indicate that the higher the fraction of female independent directors on a board, the lower the securities litigation risk. Female non-independent directors do not affect the litigation risk as indicated by the coefficient of the *Female non-ind ratio*, which is statistically insignificant in all the columns of Table 2.3.

<Insert Table 2.3 here>

To address the potential reverse causality, we run a two-stage IV probit regression discussed in section 2.3.1.1. We utilize instruments *Male connection* and *County female ratio* that are correlated with *Female ind ratio* but uncorrelated with litigation risk. Table 2.4 presents the results of the first stage [relation (3)] and the second stage [relation (4)] of the IV approach. Column 1 reports the results of the first stage where *Female ind ratio* is regressed on the above two instruments (*Male connection* and *County female ratio*) and other covariates described in relation (2). The estimated coefficients of *Male Connection* and *County female ratio* are 0.0957 and 0.0399, respectively, both statistically significant at the 1 percent level. We also run the relevance test to examine the strength of our instruments. The partial F-statistic of 340.91 indicates that these instruments have a strong first stage and that they have more than adequate explanatory power for the *Female ind ratio*. The typical rule for adequacy of an instrument is to have minimum F-statistic of 10 (See for example, Stock et al., 2002).

In Column 2 of Table 2.4, we present the results of the second stage of IV probit model [relation (4)]. The coefficient of the Predicted *female ind ratio* is -1.598, which is statistically significant at the 5 percent level. These results confirm that *Female ind ratio* has a significant negative effect on securities litigation risk, even after controlling for endogeneity.[24]

< Insert Table 2.4 here>

As we discussed in section 2.2.3.2, in alternative models, we use the number of female independent directors to capture gender diversity on a corporate board. In Column 1 of Table 2.5, we estimate relation (5) discussed earlier in section 2.2.3.2. The marginal effect of $Female\ ind\ 1_{t-1}$ is not significantly different than zero. The marginal effect of $Female\ ind\ 2_{t-1}$ is -0.016, statistically significant at 5 percent level. The marginal effect of $Female\ ind \geqslant 3_{t-1}$ is -0.0322, statistically significant at 1 percent level. The marginal effect of $Female\ non-ind\ _{t-1}$ is statistically insignificant.

[24] As a robustness, we use each of these two instruments variables individually and find similar result.

For further robustness, we lag key explanatory variables by two years and report our results in Column 2 of Table 2.5. The marginal effects of $Female\ ind\ 1_{t-2}$, $Female\ ind\ 2_{t-2}$ and $Female\ ind \geqslant 3_{t-2}$ are -0.0122, -0.0153 and -0.0323, and they are statistically significant at the 5 percent, 5 percent and 1 percent levels, respectively. We further use conditional fixed effects logit models (Columns 3 and 4 of Table 2.5) and LPM (Columns 5 and 6 of Table 2.5) and obtain similar results. These results suggest that the effectiveness of having three or more female independent directors in reducing litigation risk is substantially higher than the effectiveness of having only one or two female independent directors.

< Insert Table 2.5 here>

To correct for the self-selection bias, we use Heckman's correction models, as discussed in section 2.3.2.1. We report our results in Table 2.6. As Column 1 indicates, the coefficients of *Female ind 1* is not statistically different than zero after including inverse mills ratio in the second stage of Heckman's model. However, as Columns 3 and 5 indicate, the coefficients of *Female ind 2* and *Ind female*$\geqslant$ *3* are still negative and statistically significant at 1 percent after correction for the self-selection bias.

To further control for the potential concerns of endogeneity and self-selection bias, we run the litigation probit models using the propensity score-matched samples discussed in section 2.3.2.2. Column 2 of Table 2.6 shows that the coefficients of *Female ind 1* is not statistically different than zero. However, Columns 4 and 6 display that the coefficients of *Female ind 2* and *Female ind* $\geqslant$ *3* are negative and statistically significant at 1 percent.

< Insert Table 2.6 here>

2.4.3 Firm's monitoring costs and effectiveness of female independent directors

In our second hypothesis, we test if the effectiveness of female independent directors in moderating securities litigation risk decreases as firm's monitoring costs increase. For our empirical test, we estimate probit model specifications based on relation (9) as discussed in section 2.3.3 and present our results in Column 1 of Table 2.7. Relation (9) includes *MC index* and the interaction of *MC index* and *Female ind ratio* (*Female ind ratio*MC index*) as explanatory variables. The coefficient of *MC index* is statistically insignificant, suggesting that monitoring costs alone do not influence securities litigation risk. However, the coefficient of *Female ind ratio*MC index* is positive and statistically significant, indicating that the effectiveness of female independent directors in reducing the litigation risk dilutes in firms with high monitoring costs. Next, in Column 2 of Table 2.7, we replicate the above analysis using the interaction of *Male ind ratio* and *MC index* (*Male ind ratio*MC index*) to examine if a firm's monitoring costs influence male independent directors' effects on litigation risk. The coefficient of *Male ind ratio*MC index* is statistically insignificant, indicating that the firm's monitoring costs do not affect the impact of male independent directors on litigation risk.

We further estimate the marginal effect of *Female ind ratio* on the probability of lawsuits against firms for different levels *of MC index* and present our results in Column 1 of Table 2.8. As the *MC index* increases from 0 to 1, the average marginal effects of *Female ind ratio* on litigation risk increases monotonously from -0.12 to +0.02. The average marginal effects of *Female ind ratio* on litigation risk are negative and statistically significant when the *MC index* is below 0.6. However, when the *MC index* is higher than 0.6, the average marginal effect of the *Female ind ratio* becomes statistically insignificant.

In Column 2 of Table 2.8, we present the average marginal effects of *Male ind ratio* on litigation risk for different levels of *MC index*. We do not observe any patterns relating the effect of male independent directors to a firm's monitoring costs.

<Insert Table 2.7 here>

<Insert Table 2.8 here>

2.4.4 Firm's complexity and effectiveness of female independent directors

In our third hypothesis, we test if the effectiveness of female independent directors in moderating securities litigation risk improves as the complexity of the firm increases. In Column 3 of Table 2.7, we estimate probit model specifications based on relation (10) as discussed in section 2.3.3. Relation (10) includes firm *COM index* and the interaction of firm *COM index* and *Female ind ratio* (*Female ind ratio*COM index*) as explanatory variables. The coefficient of *COM index* is statistically insignificant, suggesting that firm's complexity does not influence securities litigation risk. However, the coefficient of *Female ind ratio*COM index* is negative and statistically significant, indicating that the effectiveness of female independent directors in reducing the litigation risk improves with firm complexity. In addition, in Column 4, we replicate the above analysis using the interaction of *Male ind ratio* and *COM index* (*Male ind ratio*COM index*) to examine if male independent directors' effects on litigation risk is influenced by firm's complexity. The coefficient of *Male ind ratio*COM index* is not statistically significant, indicating that the firm's complexity does not influence the impact that male independent directors have on litigation risk.

We further estimate the marginal effect of *Female ind ratio* on the probability of lawsuits against the firm for different levels of firm complexity index and report our results in Column 3 of Table 2.8. As *COM index* increases from 0 to 1, the average marginal effects of *Female ind ratio* on litigation risk decreases monotonously from +0.05 to -0.11. The average marginal effects of *Female ind ratio* on litigation risk is statistically insignificant when the *COM index* is below 0.5. However, for a *COM index* higher than 0.5, the average marginal effect of *Female ind ratio* is negative and statistically significant. In Column 4 of Table 2.8, we present the average marginal effects of *Male ind ratio* on litigation risk for different levels of monitoring cost index. We do not observe any relation between a firm's complexity and male independent directors' influence on litigation risk.

In Figure 2.2, we show the marginal effects of *Female ind ratio* and *Male ind ratio* on litigation risk for different levels of *MC index* and *COM index*. The plot in Figure 2.2 confirms the findings of Tables 2.7 and 2.8.

<Insert Figure 2.2 Here>

2.4.5 Alleviating endogeneity concerns related to monitoring costs and firm's complexity

Endogeneity is a potential concern in measuring the impact of monitoring costs or firm complexity on the effectiveness of female independent directors in reducing litigation risk. In order to address the potential endogeneity, we apply two-stage IV probit model. As discussed earlier in section 2.3.1.1, we use *Male connected* and *County female ratio* as instruments for *Female ind ratio*. We instrument *Female ind ratio*MC index* with *County female ratio*MC index* and *Male connected*MC index*. The first instrument is the interaction of *County female ratio* with *MC index* and the latter is the interaction of *Male connected* with *MC index*. In a similar way, we use *County female ratio* COM index* and *Male connected*COM index* as instruments for *Female ind ratio *COM index*. In the first stage regressions, we regress *Female ind ratio*, *Female ind ratio*MC index and Female* *ind ratio * COM index* on the instruments and other covariates to get the predicted values for these variables. In the second stage, we run probit regressions where dependent variable is *Security lit* and we include predicted values of *Female ind ratio* and *Female ind ratio*MC index* in one specification, and *Female ind ratio* and *Female ind ratio*COM index* in the other specification. We report the results in Table 2.9. Column 1 shows that the coefficient of predicted *Female ind ratio*MC index* is positive and statistically significant at 5 percent level. Also, in Column 2, the coefficient of *Female ind ratio*COM index* is negative and statistically significant at 5 percent level. These results confirm that the effectiveness of female independent directors in reducing litigation risk increases with decrease in firm's monitoring costs and increase in firm's complexity.

<Insert Table 2.9>

2.5 Channels through which board gender diversity may reduce litigation risk

2.5.1 Higher board participation

As we discussed in the introduction section, one potential channel through which female directors may affect litigation risk is board attendance. In order to measure the effect of board gender diversity on board attendance, we use an approach similar to Adams and Ferreira (2009). They analyze gender effect on each individual directors' participation, while we investigate the effect of board gender diversity on board participation. We employ the following probit models:

$$Att\ issue_{i,t} = \beta_0 + \beta_1(Female\ ind\ ratio_{i,t}) + \beta_2(Female\ non-ind\ ratio_{i,t}) + \theta \boldsymbol{Z}_{i,t-1} + I_j + Y_t + \varepsilon_{i,t} \tag{11}$$

The dependent variable (*Att issue*) is a dummy, which equals one if at least one of the firm's directors attends less than 75 percent of the annual meetings. We use the ratio of female independent directors and female non-independent directors on a board as the gender diversity variables. Vector ***Z*** represents other controls, including the proportion of male independent directors on a board (*Male ind ratio*), female CEO, female CFO, CEO tenure, CEO turnover, board size, CEO duality, board's average age, board's age diversification, Log(sale), volatility (*Return sd*), Tobin's Q, and ROA. Our choice of controls is similar to Adams and Ferreira (2009).

In Table 2.10, we present the results of probit regression based on relation (11). The coefficient of *Female ind ratio* is negative and statistically significant at the 5 percent level. The average marginal effect of *Female ind ratio* on the probability that a firm has a board attendance problem (one of the directors attends less than 75 percent of the annual meetings) is -0.07 and statistically significant at the 5 percent level. However, the coefficients of *Female non-ind ratio* and *Male ind ratio* is statistically insignificant. Our empirical results indicate that a higher female presence on a company board is associated with higher board participation, which may lead to improved monitoring and hence lower litigation risk.

<Insert Table 2.10>

2.5.2 Conditional conservatism

Conditional accounting conservatism is another potential mechanism through which board gender diversity may reduce litigation risk. Following Basu and Liang (2019), we use the following model to measure conditional conservatism:

$$Earn_{i,t} = \beta_1(Ret_{i,t}) + \beta_2(Bad_{i,t}) + \beta_3(Ret * Bad_{i,t}) + \alpha_i + Y_t + \varepsilon_{i,t} \quad (12)$$

Where, *Earn* is the income before extraordinary items scaled by beginning-of-year market value of equity. *Ret* is the market-adjusted stock return over the fiscal year (starting from three months after the fiscal year starts). *Bad* is a dummy that equals 1 if *Ret* < 0, and 0 otherwise. *Ret * Bad* is the interaction of *Ret* and *Bad*. α_i and Y_t represent firm and year fixed effects. β_3 in relation (12) captures the conditional accounting conservativeness (the difference in earning timeliness between good news and bad news).

In order to measure the effect of board gender diversity on conditional accounting conservativeness, we interact every term except fixed effects in relation (12) with *Female ind ratio* and estimate the following regression model:

$$Earn_{i,t} = \beta_1(Ret_{i,t}) + \beta_2(Bad_{\ i,t}) + \beta_3(Ret * Bad_{i,t}) + Ind\ female\ ratio_{i,t}\ [\beta_4 + \beta_5(Ret_{i,t}) + \beta_6(Bad_{i,t}) + \beta_7(Ret * Bad_{i,t})] + \alpha_i + Y_t + \varepsilon_{i,t} \quad (13)$$

β_7 in relation (13) captures the effect of *Female ind ratio* on conditional accounting conservativeness.

Further, the conditional conservativeness measured through relation (13) might arise from operating accruals (*Accr*) and/or operation cash flows (*Ocf*). Several researchers argue that only asymmetric timeliness of *Accr* can be interpreted as conditional conservativeness (e.g., Hsu et al., 2012; and Collins et al., 2014). To address this concern, following Collins et al. (2014), we replace the dependent variable in relation (13) with *Accr* or *Ocf* and estimate it again.

In Table 2.11, we present the results for the regression model based on relation (13). In Column 1, the dependent variable is *Earn.* The coefficient of interaction of *Ret, Bad* and *Female ind ratio* (*Ret * Bad * Female ind ratio*) is positive and statistically significant at 5 percent level. In Column 3, we replace the dependent variable with *Accr*. The coefficient of *Ret * Bad * Female ind ratio* is still positive and statistically significant at 1 percent level. However, when we replace the dependent with *Ocf* in Column 5, the coefficient of *Ret * Bad * Female ind ratio* is statistically insignificant. These results indicate that firms with higher representation of female independent directors on their boards exhibit higher conditional accounting conservativeness. These findings come from the operating accruals, which is more relevant to the concept of conditional conservatism.

In addition, we run similar analyses by replacing *Female ind ratio* with *Male ind ratio* and present our results in Columns 2, 4 and 6 of Table 2.11. Coefficient of *Ret * Bad * Male ind ratio* is not statistically different from zero in all specifications. These results indicate that firms with higher representation of male independent directors on their boards do not exhibit higher conditional accounting conservativeness.

Overall, we find that firms with higher representation of female independent directors on their boards are more conservative in their earnings reports. Therefore, their stocks are less likely to be overvalued, and subsequently, the likelihood of dramatic stock price crashes that can trigger securities litigation is lower.

<Insert Table 2.11>

2.6 Conclusions

The shareholders of firm that are target of securities litigation incur substantial losses. The effective monitoring of management is one of the ways that shareholders may exploit to reduce the probability of securities litigation. There is empirical evidence that female independent directors are tougher monitors compared to their male counterparts (See for example, Adams and Ferreira, 2009). In this paper, we argue that if presence of female independent directors on a corporate board improves monitoring, it should alleviate firm's litigation risk also. Using securities litigation data for S&P 1500 firms over a period from 1998 to 2017, we investigate if a higher representation of female independent directors on company board reduces its securities litigation risk. We find that the larger the fraction of female independent directors on company boards, the lower the litigation risk. We address possible endogeneity concerns by using conditional fixed effects logit model, linear probability model (LPM) with firm fixed effects, two-stage instrumental variables (IV) probit model, Heckman correction model, and propensity score matching methodology. We consistently find that increase in the fraction of female independent directors on a board reduces the probability of a security lawsuit against the firm.

Literature shows that one-size-fits-all governance remedy of intense monitoring of management to reduce agency costs is suboptimal. Intense monitoring of management is less effective in firms with higher monitoring costs and firms with lower complexity (e.g. Coles, 2008; Wintoki, 2007). Therefore, we test if monitoring costs and complexity of a firm influence the effectiveness of female independent directors in moderating the securities litigation risk. Our empirical analysis shows that the effectiveness of female independent directors in reducing litigation risk is negatively related to a firm's monitoring costs and is positively related to a firm's complexity.

We further identify potential channels through which gender diversity on a board may lower the litigation risk. We find that a higher fraction of female independent directors on a board enhances board participation, which may improve monitoring of management thereby reducing litigation risk. In addition, we explore conditional accounting conservatism as another potential channel through which board gender diversity reduces litigation risk. Our findings indicate that firms with higher representation of female independent directors on their boards exhibit higher conditional accounting conservativeness. Conditional conservatism can lower the likelihood of overvaluation of stocks, and hence the subsequent potential dramatic stock price fall, reducing the likelihood of securities lawsuits against a firm.

Figure 2.1. Litigation Trends

This figure shows the annual percentage of firms involved in securities litigation in our sample.

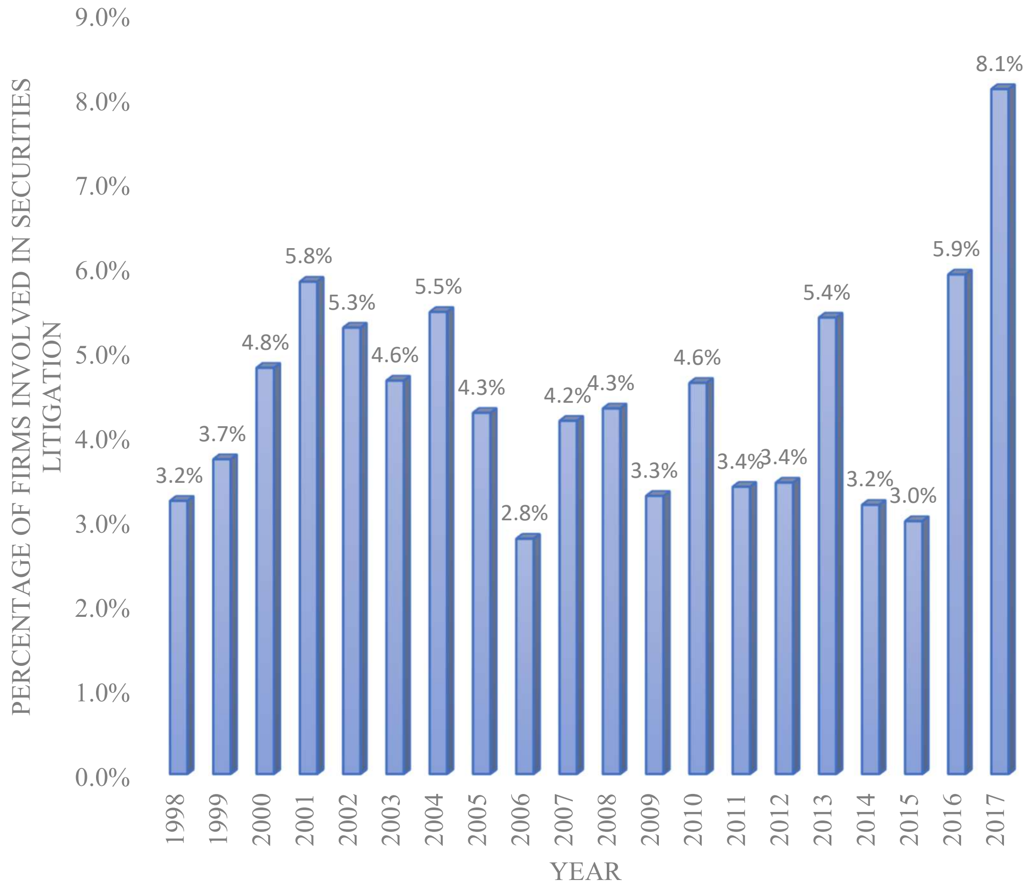

Figure 2.2. Average marginal effect of female independent ratio on the probability of filing a security lawsuit

Average marginal effects of *Female ind ratio* and *Male ind ratio* on the probability of a security lawsuit filing against a firm are depicted for different levels of Monitoring cost index (MC index) and Complexity index (COM index) in Figures 2.a and 2.b, respectively. *Female ind ratio* is the ratio of female independent directors to total number of board directors at the end of year t-1 and *Male ind ratio* is the ratio of male independent board directors to the total number of board directors at the end of year t-1. Construction of MC index and COM index is explained in section 2.4.3. These marginal effects are based on the estimates presented in Table 2.8. The average marginal effects are shown by solid black lines. The 95 percent confidence intervals for the average marginal effects are shown by dashed lines. The hashed area indicates where the marginal effects are negative and statistically significant at the 5 percent level.

Figure 2.2.a

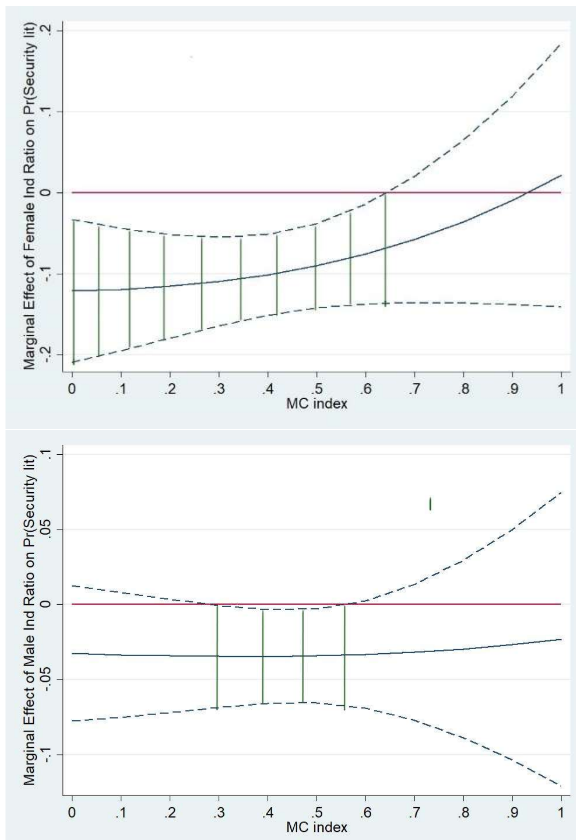

Figure 2.2.b

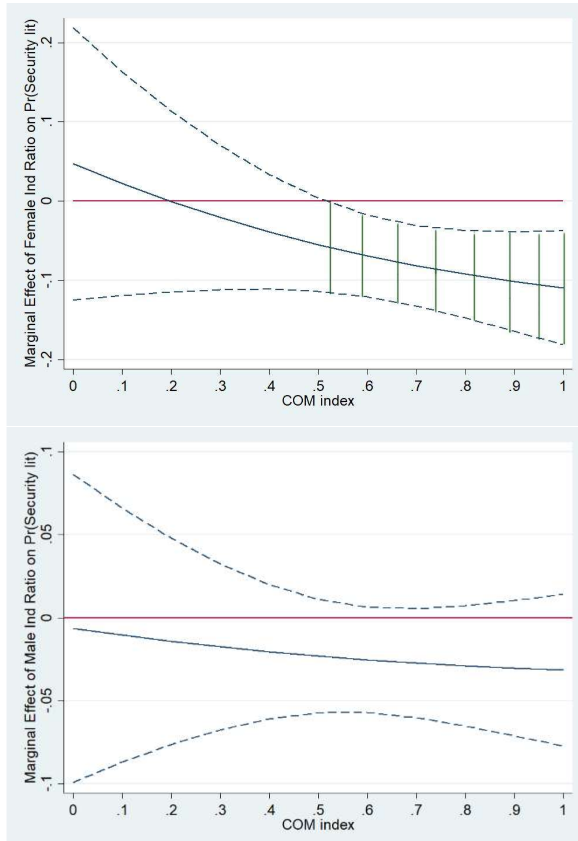
Marginal Effect of Female Ind Ratio on Pr(Security lit)
COM index
Marginal Effect of Male Ind Ratio on Pr(Security lit)
COM index

Table 2.1. Summary statistics

This table summarizes descriptive statistics of the major variables used in this study. N is number of observations. Mean is the average of firm-year observations. Min is minimum of firm-year observations. Max is maximum of firm-year observations. SD is the standard deviation of firm-year observations. We provide the definition of each of these variables in Appendix A.

Variables	N	Mean	Min	Max	SD
Dependent Variables					
Security lit	18,334	0.0438	0.0000	1.0000	0.2050
ATT issue	18,334	0.0891	0.0000	1.0000	0.2849
Earn	17,645	0.0330	-0.4724	0.2107	0.0892
Accr	15,535	-0.0516	-0.5645	0.1807	0.1007
Ocf	15,535	0.0826	-0.3183	0.5157	0.1086
Board & CEO Characteristics					
Female ind ratio	18,334	0.0990	0.0000	0.5450	0.0962
Female non-ind ratio	18,334	0.0066	0.0000	0.3330	0.0287
Female ind 1	18,334	0.3550	0.0000	1.0000	0.4790
Female ind 2	18,334	0.1920	0.0000	1.0000	0.3930
Female ind ⩾ 3	18,334	0.0646	0.0000	1.0000	0.2460
Female non-ind	18,334	0.0557	0.0000	1.0000	0.2290
Female CEO	17,746	0.0277	0.0000	1.0000	0.1640
Female CFO	17,746	0.0545	0.0000	1.0000	0.2270
CEO turnover	17,746	0.1080	0.0000	1.0000	0.3110
CEO tenure	17,746	0.8620	0.0000	3.9890	1.0820
Male ind ratio	18,334	0.6300	0.0000	1.0000	0.1510
Board age diversification	18,334	7.8832	3.1270	14.7022	2.4285
Board average age	18,334	60.8600	49.400	70.8571	4.2367
County ratio	16,803	0.1180	0.0000	0.6250	0.0567
Connection ratio	18,334	0.2760	0.0000	0.9100	0.2390
Duality	18,334	0.4200	0.0000	1.0000	0.4940
Board ind	18,334	0.7290	0.0000	1.0000	0.1590
Insider own	18,328	0.0819	0.0000	14.9500	0.1890
Board size	18,334	2.2770	1.3860	3.0910	0.2260
Firm Characteristics					
Foreign segment	18,334	0.6630	0.0000	1.0000	0.4730
Free cash	17,109	0.0862	-0.1800	0.2660	0.0657
Bad	18,331	0.5117	0.0000	1.000	0.4999
Capex	18,232	0.0514	0.0000	1.2050	0.0529
leverage	18,262	0.2160	0.0000	0.7640	0.1760
R&D	18,334	0.0316	0.0000	0.2310	0.0502
Tangibility	18,315	0.2600	0.0018	0.8790	0.2140
ROA	18,333	0.0473	-0.3600	0.2460	0.0900
Size	18,333	7.5520	4.7380	12.4600	1.5240
Sales growth	18,333	0.0594	-0.5600	0.5970	0.1740
Turnover	18,326	24.2600	2.2210	91.5600	17.4800
Sd12	18,324	0.0990	0.0258	0.3190	0.0566
Skew12	18,299	0.1300	-1.5060	1.8920	0.6650
Ret	18,331	0.0354	-0.7782	1.7387	0.4095
Return	18,326	0.0070	-0.0778	0.0976	0.0300
Frim age	18,334	24.3400	0.0000	67.0000	15.7000
Tobin's Q	18,328	2.0674	0.7886	7.4266	1.2448
Log(sale)	18,333	7.4567	4.0822	11.4733	1.5259
Market-to-book	18,281	3.2400	-9.6330	24.4200	3.7910
MC index	18,305	0.5040	0.0000	1.0000	0.2820
COM index	18,253	0.5530	0.0000	1.0000	0.2790

Table 2.2. Breakdown of security lawsuits by industry

This table provides the number and percentage of firm-year observations in our sample that are involved in security litigations against firms by industry. The industry classification is based on two-digit SIC codes. Percentages are calculated by dividing the number of lawsuits in each industry by the total number of firm-year observations for that industry.

SIC Code	Description	Number of firm years in sample	Number of firm years involved in litigation	Percentage of firm years involved in litigation
01	Agricultural Production - Crops	28	3	10.71%
02	Agricultural Production - Livestock and Animal Specialties	9	0	0.00%
07	Agricultural Services	13	0	0.00%
10	Metal Mining	51	4	7.84%
12	Coal Mining	23	2	8.70%
13	Oil and Gas Extraction	730	25	3.42%
14	Mining and Quarrying of Nonmetallic Minerals, Except Fuels	72	2	2.78%
15	Construction - General Contractors & Operative Builders	205	3	1.46%
16	Heavy Construction, Except Building Construction, Contractor	119	4	3.36%
17	Construction - Special Trade Contractors	44	1	2.27%
20	Food and Kindred Products	637	27	4.24%
21	Tobacco Products	62	2	3.23%
22	Textile Mill Products	83	0	0.00%
23	Apparel, Finished Products from Fabrics & Similar Materials	214	7	3.27%
24	Lumber and Wood Products, Except Furniture	159	2	1.26%
25	Furniture and Fixtures	145	3	2.07%
26	Paper and Allied Products	355	7	1.97%
27	Printing, Publishing and Allied Industries	255	1	0.39%
28	Chemicals and Allied Products	1676	105	6.26%
29	Petroleum Refining and Related Industries	174	5	2.87%
30	Rubber and Miscellaneous Plastic Products	231	5	2.16%
31	Leather and Leather Products	96	2	2.08%
32	Stone, Clay, Glass, and Concrete Products	134	3	2.24%
33	Primary Metal Industries	395	9	2.28%
34	Fabricated Metal Products	356	3	0.84%

35	Industrial and Commercial Machinery and Computer Equipment	1396	58	4.15%
36	Electronic & Other Electrical Equipment & Components	1700	74	4.35%
37	Transportation Equipment	670	28	4.18%
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	1320	60	4.55%
39	Miscellaneous Manufacturing Industries	180	10	5.56%
40	Railroad Transportation	82	1	1.22%
41	Local & Suburban Transit & Interurban Highway Transportation	7	0	0.00%
42	Motor Freight Transportation	198	5	2.53%
44	Water Transportation	74	2	2.70%
45	Transportation by Air	190	5	2.63%
47	Transportation Services	83	3	3.61%
48	Communications	392	37	9.44%
50	Wholesale Trade - Durable Goods	530	13	2.45%
51	Wholesale Trade - Nondurable Goods	290	15	5.17%
52	Building Materials, Hardware, Garden Supplies & Mobile Homes	64	5	7.81%
53	General Merchandise Stores	257	16	6.23%
54	Food Stores	104	7	6.73%
55	Automotive Dealers and Gasoline Service Stations	163	4	2.45%
56	Apparel and Accessory Stores	375	7	1.87%
57	Home Furniture, Furnishings and Equipment Stores	136	5	3.68%
58	Eating and Drinking Places	412	11	2.67%
59	Miscellaneous Retail	373	23	6.17%
60	Depository Institutions	1633	109	6.67%
70	Hotels, Rooming Houses, Camps, and Other Lodging Places	45	2	4.44%
72	Personal Services	95	7	7.37%
73	Business Services	2287	129	5.64%
75	Automotive Repair, Services and Parking	66	4	6.06%
78	Motion Pictures	60	4	6.67%
79	Amusement and Recreation Services	117	4	3.42%
80	Health Services	352	33	9.38%
82	Educational Services	88	13	14.77%
83	Social Services	12	0	0.00%
87	Engineering, Accounting, Research, and Management Services	318	14	4.40%

99	Non-classifiable Establishments	68	8	11.76%
	Total	**18770**	**832**	**4.43%**

Table 2.3. Board gender diversity and litigation risk - Base models

This table presents results of six binary regression models, where the dependent variable, *Security lit*, is a dummy that equals 1 if a security lawsuit filing against the firm occurred during the year, and 0 otherwise. The key explanatory variable, *Female ind ratio*, is the ratio of female independent directors to total number of board directors (lagged one and two years in turn). Columns 1 and 2 present results of probit regression models. Columns 3 and 4 present results of conditional fixed logit models. Columns 5 and 6 present results of linear probability models. dy/dx indicates average marginal effects of *Female ind ratio* and *Male ind ratio* on the probability of a security lawsuit filing against a firm. Other controls include *Size, Sales growth, Turnover, Return, Return sd, Return skew, R&D, Free cash, Leverage, Capex, Tangibility, Market-to-book, ROA, Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age,* and *Board age diversification*. Variables are defined in the Appendix A. t-statistics reported in parentheses is computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1) Probit**	**(2) Probit**	**(3) Cond Logit**	**(4) Cond Logit**	**(5) LPM**	**(6) LPM**
$Female\ ind\ ratio_{t-1}$	-1.083***		-3.287***		-0.136***	
	(-3.459)		(-3.012)		(-2.760)	
$Female\ ind\ ratio_{t-2}$		-1.008***		-3.119***		-0.126***
		(-3.211)		(-2.988)		(-2.730)
$Female\ non-ind\ ratio_{t-1}$	0.271	0.316	-1.398	-0.968	-0.0183	-0.00614
	(0.256)	(0.301)	(-0.376)	(-0.261)	(-0.0966)	(-0.0327)
$Male\ ind\ ratio_{t-1}$	-0.389**	-0.313*	-0.704	-0.328	-0.0306	-0.0146
	(-2.022)	(-1.680)	(-1.125)	(-0.554)	(-1.199)	(-0.620)
dy/dx (Female ind ratio)	-0.0878***	-0.0817***				
	(-3.459)	(-3.211)				
dy/dx (Male ind ratio)	-0.03150**	-0.0254*				
	(-2.022)	(-1.680)				
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	No	No	Yes	Yes
Fixed Effects	Industry	Industry	Firm	Firm	Firm	Firm
Pseudo R^2\Adj R^2	0.1138	0.1135	0.0467	0.0462	0.1860	0.1859
Observations	13,479	13,479	4,454	4,454	13,629	13,629

Table 2.4. Board gender diversity and litigation risk - IV approach

This table presents results of the two-stage IV probit model. Column (1) presents results of first stage IV regression, where *Female ind ratio* is regressed on two instrumental variables, *Male connection* and *County female ratio*, and other covariates. *Female ind ratio* is the ratio of female independent directors to total number of board directors. *Male connection* is the ratio of male directors who sit on other boards with at least one female director to the total number of male directors. *County female ratio* is the ratio of total number of female directors in the county of the firm's headquarters to the total number of directors in that county after excluding the sample firm in question. Column (2) presents results of the probit regression model, where the dependent variable *Security lit*, is a dummy that equals 1 if a security lawsuit filing against the firm occurred during the year, and 0 otherwise. Predicted value of *Female ind ratio* from first stage regression in Column (1) is included in the second stage probit regression presented in Column (2). Other controls include *Size, Sales growth, Turnover, Return, Return sd, Return skew, R&D, Free cash, Leverage, Capex, Tangibility, Market-to-book, ROA, Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age,* and *Board age diversification*. Variables are defined in the Appendix A. t-statistics reported in parentheses is computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1) IV 1^{st} stage**	**(2) IV 2^{nd} stage**
$Pred\ \ female\ ind\ ratio\ _{t-1}$		-1.598**
		(-1.982)
$Female\ non-ind\ ratio\ _{t-1}$	-0.125***	0.0288
	(-3.401)	(0.0243)
$Male\ ind\ ratio\ _{t-1}$	-0.262***	-0.508
	(-39.04)	(-1.389)
$Male\ connection\ \ _{t-1}$	0.0957***	
	(25.89)	
$County\ female\ ratio\ _{t-1}$	0.0399***	
	(2.625)	
F (2, 1106)	340.91	
Other Controls	Yes	Yes
Year Dummies	Yes	Yes
Intercept	Yes	Yes
Fixed Effects	Industry	Industry
Adj R^2 \Pseudo R^2	0.450	0.1159
Observations	12,441	12,441

Table 2.5. Board gender diversity and litigation risk – Alternative models

This table presents results of six binary regression models, where the dependent variable *Security lit*, is a dummy that equals 1 if a security lawsuit filing against the firm occurred during the year, and 0 otherwise. The key explanatory variables, *Female ind 1*, *Female ind 2* and *Female ind ⩾3* are lagged one and two years in turn. *Female ind 1* is a dummy that equals 1 if firm has only one female independent director, and 0 otherwise. *Female ind 2* is a dummy that equals 1 if firm has only two female independent directors, and 0 otherwise. *Female ind ⩾3* is a dummy that equals 1 if firm has three or more female independent directors, and 0 otherwise. Columns (1) and (2) present results of probit regressions models. Columns (3) and (4) present results of conditional fixed logit models. Columns (5) and (6) present results of linear probability models. dy/dx indicates average marginal effects of board gender diversity variables on probability of a security lawsuit filing against a firm. Other controls include *Size, Sales growth, Turnover, Return, Return sd, Return skew, R&D, Free cash, Leverage, Capex, Tangibility, Market-to-book, ROA, Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age,* and *Board age diversification*. Variables are defined in the Appendix A. t-statistics reported in parentheses is computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1) Probit**	**(2) Probit**	**(3) Cond Logit**	**(4) Cond Logit**	**(5) LPM**	**(6) LPM**
$Female\ ind\ 1_{t-1}$	-0.0948		-0.449**		-0.0177**	
	(-1.552)		(-2.250)		(-2.244)	
$Female\ ind\ 2_{t-1}$	-0.197**		-0.573**		-0.0241**	
	(-2.515)		(-2.184)		(-2.061)	
$Female\ ind\ \geqslant 3_{t-1}$	-0.397***		-1.061***		-0.0445**	
	(-3.448)		(-2.943)		(-2.431)	
$Female\ ind\ 1_{t-2}$		-0.150**		-0.670***		-0.0243***
		(-2.499)		(-3.460)		(-3.153)
$Female\ ind\ 2_{t-2}$		-0.188**		-0.588**		-0.0219*
		(-2.432)		(-2.397)		(-1.896)
$Female\ ind\ \geqslant 3_{t-2}$		-0.405***		-1.069***		-0.0440***
		(-3.508)		(-3.128)		(-2.611)
$Female\ non-ind_{t-1}$	-0.137	-0.130	-0.526	-0.491	-0.0144	-0.0131
	(-1.140)	(-1.075)	(-1.234)	(-1.141)	(-0.872)	(-0.803)
$Male\ ind\ ratio_{t-1}$	-0.392**	-0.331*	-0.625	-0.309	-0.0255	-0.0126
	(-2.046)	(-1.779)	(-1.006)	(-0.520)	(-1.007)	(-0.532)
dy/dx (Female ind 1)	-0.0077	-0.0122**				
	(-1.552)	(-2.499)				
dy/dx (Female ind 2)	-.0160**	-0.0153**				
	(-2.515)	(-2.432)				
dy/dx(Female ind ⩾ 3)	-0.0322***	-0.0323***				
	(-3.448)	(-3.508)				
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	No	No	Yes	Yes
Fixed Effects	Industry	Industry	Firm	Firm	Firm	Firm
Pseudo R^2\Adj R^2	0.1139	0.1142	0.0467	0.0495	0.1860	0.1864
Observations	13,479	13,479	4,454	4,454	13,629	13,629

Table 2.6. Board gender diversity and litigation risk – Heckman and propensity score matching models

This table presents results from addressing endogeneity using the Heckman two-step procedure and propensity score matching. Columns (1), (3) and (5) present the results of second stage of Heckman correction model, where the dependent variable is *Security lit*, a dummy that equals 1 if a security lawsuit filing against the firm occurred during the year, and 0 otherwise. Columns (2), (4) and (6) present the result of probit regression using a propensity score matched sample, where the dependent variable is *Security lit*. *Female ind 1* is a dummy that equals 1 if firm has only one female independent director, and 0 otherwise. *Female ind 2* is a dummy that equals 1 if firm has only two female independent directors, and 0 otherwise. *Female ind ⩾ 3* is a dummy that equals 1 if firm has three or more female independent directors, and 0 otherwise. Other controls include *Size, Sales growth, Turnover, Return, Return sd, Return skew, R&D, Free cash, Leverage, Capex, Tangibility, Market-to-book, ROA, Male ind ratio, Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age,* and *Board age diversification*. Variables are defined in the Appendix A. t-statistics reported in parentheses is computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Female ind 1		**Female ind 2**		**Female ind ⩾ 3**	
Variables	**(1) Heck 2nd stage**	**(2) PSM**	**(3) Heck 2nd stage**	**(4) PSM**	**(5) Heck 2nd stage**	**(6) PSM**
$Female\ ind\ 1_{t-1}$	-0.0930	-0.0867				
	(-1.417)	(-1.368)				
$Female\ ind\ 2_{t-1}$			-0.259***	-0.263***		
			(-2.778)	(-2.693)		
$Female\ ind\ \geqslant 3_{t-1}$					-0.639***	-0.621***
					(-4.096)	(-2.855)
$Female\ non-ind_{t-1}$	-0.0337	-0.0910	-0.307	-0.167	-0.441**	-0.441
	(-0.229)	(-0.649)	(-1.620)	(-0.913)	(-2.061)	(-1.299)
$Inverse\ mills\ ratio_{t-1}$	-0.168		0.0353		0.0296	
	(-1.111)		(0.438)		(0.513)	
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.1141	0.1139	0.1309	0.1288	0.1275	0.1789
Observations	7,509	7,771	5,687	4,996	3,888	1,421

Table 2.7. Monitoring cost and firm complexity indices, and effect of female independent directors on litigation risk

This table presents results of probit regression of security litigation on *Female ind ratio* and other covariates. *Female ind ratio* is the ratio of female independent directors to total number of board directors. In all specifications, the dependent variable is *Security lit*, a dummy that equals 1 if a security lawsuit filing against the firm occurred during the year, and 0 otherwise. In Column (1), MC index is monitoring cost index and *Female ind ratio*MC index* is the interaction of *Female ind ratio* and *MC index*. In Column (2), *Male ind ratio*MC index* is the interaction of *Male ind ratio* and *MC index*. In Column (3), *COM index* is firm complexity index and *Female ind ratio*COM index* is the interaction of *Female ind ratio* and *COM index*. In Column (4), *Male ind ratio*COM index* is the interaction of *Male ind ratio* and *COM index*. Other controls include *Size, Sales growth, Turnover, Return, Return sd, Return skew, R&D, Free cash, Leverage, Capex, Tangibility, Market-to-book, ROA, Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age*, and *Board age diversification*. Variables are defined in the Appendix A. t-statistics reported in parentheses is computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1)**	**(2)**	**(3)**	**(4)**
$Female\ ind\ ratio_{t-1}$	-2.316***	-1.095***	0.412	-0.887***
	(-3.707)	(-3.492)	(0.544)	(-2.744)
$MC\ index_{t-1}$	0.306	0.306		
	(0.974)	(0.559)		
$Female\ ind\ ratio * MC\ index_{t-1}$	2.485**			
	(2.234)			
$COM\ index_{t-1}$			-0.136	-0.0724
			(-0.685)	(-0.158)
$Female\ ind\ ratio * COM\ index_{t-1}$			-2.079*	
			(-1.909)	
$Female\ non-ind\ ratio_{t-1}$	0.179	0.261	0.256	
	(0.169)	(0.245)	(0.235)	
$Male\ ind\ ratio_{t-1}$	-0.402**	-0.641	-0.311	-0.0583
	(-2.091)	(-1.539)	(-1.565)	(-0.134)
$Male\ ind\ ratio * MC\ index_{t-1}$		0.459		
		(0.649)		
$Male\ ind\ ratio * COM\ index_{t-1}$				-0.426
				(-0.630)
Other Controls	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Fixed Effects	Industry	Industry	Industry	Industry
Pseudo R^2	0.1161	0.1156	0.1162	0.1163
Observations	13,479	13,479	13,452	13,452

Table 2.8. Average marginal effects of female independent directors on security litigation risk for different levels of monitoring cost and firm complexity indices

This table presents average marginal effects of *Female ind ratio* and *Male ind ratio* on probability of a security lawsuit filing against a firm for different levels of MC Index and COM index based on probit regression models in Table 2.7. dy/dx (F) in Columns (1) and (3) indicates average marginal effects of *Female ind ratio* for different levels of MC Index, and COM index, respectively. dy/dx (M) in Columns (2) and (4) indicates average marginal effects of *Male ind ratio* for different levels of MC Index and COM index, respectively. Variables are defined in Appendix A. t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

MC index	**(1) dy/dx (F)**	**(2) dy/dx (M)**	**COM index**	**(3) dy/dx (F)**	**(4) dy/dx (M)**
0	-0.1212***	-0.0325	0	0.047	-0.0064
	(-2.69)	(-1.41)		(0.54)	(-0.13)
0.1	-0.1193***	-0.0335	0.1	0.0221	-0.0105
	(-3.09)	(-1.57)		(0.31)	(-0.27)
0.2	-0.1156***	-0.0342*	0.2	-0.0004	-0.0142
	(-3.54)	(-1.77)		(-0.01)	(-0.45)
0.3	-0.1098***	-0.0346**	0.3	-0.0207	-0.0175
	(-3.93)	(-2.00)		(-0.44)	(-0.69)
0.4	-0.1014***	-0.0346**	0.4	-0.0388	-0.0205
	(-3.98)	(-2.17)		(-1.05)	(-0.99)
0.5	-0.0902***	-0.0342**	0.5	-0.0548*	-0.0231
	(-3.41)	(-2.14)		(-1.82)	(-1.32)
0.6	-0.0758**	-0.0333*	0.6	-0.0690***	-0.0254
	(-2.41)	(-1.82)		(-2.62)	(-1.57)
0.7	-0.0578	-0.0318	0.7	-0.0814***	-0.0273
	(-1.45)	(-1.38)		(-3.14)	(-1.63)
0.8	-0.0358	-0.0297	0.8	-0.0922***	-0.0290
	(-0.7)	(-0.98)		(-3.27)	(-1.57)
0.9	-0.0095	-0.0268	0.9	-0.1014***	-0.0304
	(-0.14)	(-0.68)		(-3.17)	(-1.46)
1	0.0215	-0.0232	1	-0.1092***	-0.0316
	(0.26)	(-0.46)		(-2.98)	(-1.35)

Table 2.9. Monitoring cost and firm complexity indices, and effect of female independent directors on litigation risk – IV approach

This table presents results of the second stage of the two-stage IV probit model. The dependent variable is Security lit, a dummy that equals 1 if a security lawsuit filing against the firm occurred during the year, and 0 otherwise. Predicted values of *Female ind ratio* and *Female ind ratio*MC index* obtained from the first stage regressions are included in the second stage probit regression presented in Column (1). Predicted values of *Female ind ratio* and *Female ind ratio*COM index* obtained from the first stage regressions are included in the second stage probit regression presented in Column (2). Other controls include *Size, Sales growth, Turnover, Return, Return sd, Return skew, R&D, Free cash, Leverage, Capex, Tangibility, Market-to-book, ROA, Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age,* and *Board age diversification*. Variables are defined in the Appendix A. t-statistics reported in parentheses is computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1)**	**(2)**
$Pred\ female\ ind\ ratio_{\ t-1}$	-3.909**	1.071
	(-2.288)	(0.533)
$MC\ index_{\ t-1}$	0.237	
	(0.642)	
$Pred\ female\ ind\ ratio * MC\ index_{\ t-1}$	5.390**	
	(2.543)	
$COM\ index_{\ t-1}$		-0.121
		(-0.345)
$Pred\ female\ ind\ ratio * COM\ index_{\ \mathbf{t-1}}$		-3.705**
		(-2.101)
$Female\ non-ind\ ratio_{\ t-1}$	-0.0871	0.0606
	(-0.085)	(0.0588)
$Male\ ind\ ratio_{\ t-1}$	-0.491	-0.406
	(-1.297)	(-1.014)
Other Controls	Yes	Yes
Year Dummies	Yes	Yes
Intercept	Yes	Yes
Fixed Effects	Industry	Industry
Pseudo R^2	0.1156	0.1161
Observations	12,441	12,441

Table 2.10. Board gender diversity and board attendance problem

This table presents results of two probit regression models, where the dependent variable is *Att issue*, a dummy that equals 1 if at least one of the firm's board directors attends less than 75% of board meetings during the year. The key explanatory variable, *Female ind ratio*, is the ratio of female independent directors to total number of board directors Other controls include *Female CEO, Female CFO, CEO tenure, CEO turnover, Board size, Duality, Board average age, Board age diversification, Log(sale), Return sd, Tobin's Q,* and *ROA*. Variables are defined in Appendix A. t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Variables	**(1)**
Female ind ratio	-0.462**
	(-2.250)
Female non-ind ratio	-0.342
	(-0.565)
Male ind ratio	-0.0804
	(-0.704)
dy/dx (Female ind ratio)	-0.0667**
	(-2.25)
Other Controls	Yes
Year Dummies	Yes
Intercept	Yes
Fixed Effects	Industry
Pseudo R^2	0.0921
Observations	17,711

Table 2.11. Board gender diversity and conditional conservatism

This table presents results of regression of earnings, operating accruals and operation cash flows on stock adjusted return (*Ret*), negative stock return indicator (*Bad*), *Female ind ratio*, *Male ind ratio* and their interaction terms. In Columns (1) and (2), the dependent variable is earnings (*Earn*). In Columns (3) and (4), the dependent variable is operating accruals (*Acc*r). In Columns (5) and (6), the dependent variable is operating cash flows (*Ocf*). Variables are defined in Appendix A. t-statistics (reported in parentheses) are computed based on firm-level clustered standard errors and adjusted for heteroskedasticity. *, **, and *** denote statistical significance at the10%, 5%, and 1% levels, respectively.

Variables	**(1) Earn**	**(2) Earn**	**(3) Accr**	**(4) Accr**	**(5) Ocf**	**(6) Ocf**
Ret	0.00156	0.0523***	-0.0293***	-0.0583***	0.0243***	0.0737***
	(0.469)	(4.559)	(-9.153)	(-5.049)	(5.920)	(5.051)
Bad	0.00452	0.0326**	0.00875*	-0.0108	-0.00521	0.0323*
	(0.970)	(2.282)	(1.927)	(-0.761)	(-0.897)	(1.805)
*Ret * Bad*	0.0970***	0.0513	-0.00456	0.0275	0.108***	0.0576
	(7.373)	(1.348)	(-0.356)	(0.733)	(6.587)	(1.206)
Female ind ratio	0.0626**		0.0770***		-0.0148	
	(2.240)		(2.783)		(-0.418)	
*Ret * Female ind ratio*	-0.141***		-0.298***		0.141***	
	(-3.827)		(-8.153)		(3.019)	
*Bad * Female ind ratio*	-0.0161		-0.106***		0.0894**	
	(-0.463)		(-3.105)		(2.042)	
Ret* Bad * Female ind ratio	**0.217****		**0.423*****		**-0.163**	
	(2.017)		**(4.002)**		**(-1.206)**	
Male ind ratio		0.0271*		-0.0116		0.0388*
		(1.743)		(-0.742)		(1.861)
Ret Male ind ratio*		-0.0907***		0.0226		-0.0708***
		(-4.941)		(1.223)		(-3.045)
*Bad * Male ind ratio*		-0.0439**		0.0229		-0.0481*
		(-1.981)		(1.040)		(-1.738)
Ret * Bad * Male ind Ratio		**0.0604**		**-0.0291**		**0.0741**
		(1.000)		**(-0.488)**		**(0.984)**
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.345	0.330	0.393	0.369	0.295	0.295
Observations	17,627	17,627	15,521	15,521	15,521	15,521

CHAPTER 3: BOARD INDEPENDENCE AND WORKPLACE SAFETY

3.1 Introduction

Each year, more than 3.5 million work-related injuries and illnesses occur in workplaces in the United States. The economic consequences of such incidents sum up to be over $250 billion (Leigh, 2011). A firm's workplace injury/illness rate has a negative effect on firm value, resulting from several factors including productivity losses, legal expenses, regulatory fines, and damage to the firm's reputation (Cohn and Wardlaw, 2016). Work safety is an important topic as it is considered as one of the elements of corporate social responsibility (CRS), a business self-regulation for social accountability that has substantial contributions to social welfare and economic consequences. Considering the value decreasing and substantial costs of workplace injuries and illnesses, enhancing workplace safety might be in interests of shareholders. Shareholders may assure that firms adequately follow workplace safety measures through effective monitoring of management which depends on the composition of board of directors. Despite the economic as well as financial significance of workplace safety to firms, the relation between corporate board composition and workplace safety remains understudied. In this paper, we consider one aspect of board composition, board independence, and examine its effect on workplace safety.

We argue the effect of board independence on workplace safety based on agency theory proposed by Jensen and Meckling (1976). This theory suggests that the separation of management and ownership results in conflicts of interest between management (agent) and shareholders (principals). Therefore, it is key to align the objectives of management with the interests of shareholders to improve the firm's performance. One effective way of aligning interests of these two parties is to increase board independence by hiring board directors who are independent from management control and not affiliated with the firm. Since the future career of independent directors is dependent on their current performance in their directorship, they are more concerned about their reputations than affiliated directors (Fama, 1980; Fama and Jensen, 1983; Brochet and Srinivasan, 2014). Reputational concern of independent directors motivates them to better oversee management compared to non-independent directors whose future careers are somewhat determined within the firm, resulting in better representation of shareholders' interests by independent directors (Weisbach, 1988; Petra, 2006; Armstrong et al., 2014; Jiang et al., 2015; Chen et al., 2015).

A firm's decisions on safety measures largely affect the future financial health of the firm. Workplace safety has implications for not only the firm's value, which is the primary interest of shareholders, but also the employees' well-being, which could eventually result in better performance of the firm. Given that independent directors are more concerned about their reputations and better represent shareholders' interests, resulting in being better monitors than inside directors, we hypothesize that firms with a higher proportion of independent directors in their board practice better safety measures since management is under tougher scrutiny to avoid negative outcomes of workplace incidents. Thus, we officially posit the following hypothesis:

Hypothesis: Board independence has a negative impact on the workplace injury/illness rates.

We test this hypothesis using a sample of the S&P 1500 firms' establishments which are covered in the workplace safety data obtained from the Occupational Safety Health Administration (OSHA) from 2002 to 2011.[25] After controlling for establishment-level and firm-level characteristics as well as establishment (or firm) and year fixed effects, we find that workplace injury/illness rates are negatively related to board independence. The two-stage least squares (2SLS) regression analysis, employed to address endogeneity concerns, also shows that board independence has a negative impact on workplace injury/illness rates.

Our study contributes to the literature on workplace safety and firm's value. Cohn and Wardlaw (2016) show that workplace injury/illness rates are positively related to leverage, and the rates increase with negative cash flow shocks and decrease with positive cash flow shocks. They argue that the firm's value declines significantly with injury/illness rates. Cohn et al. (2017) study the effect of private equity-backed leveraged buyouts on workplace safety at acquired firms and document a significant decline in workplace injury/illness rates following private equity buyouts of publicly traded firms. The decline may be explained by the alleviation of pressure from public markets to meet earnings expectations, resulting in compromising workplace safety through cost reduction. Caskey and Ozel (2017) study the relation between employee safety and managers' pressure to meet analysts' earnings expectations and report significantly higher injury/illness rates in firms that meet or barely beat analyst forecasts than in firms that widely miss or

[25] OSHA regulates workplace safety for private sector companies in the U.S., and the OSHA Data Initiative Program (ODI) conducted a survey of private sector establishments and reported injuries and illnesses due to work-related activities.

comfortably beat analyst forecasts. Our paper is closely related to the current study by Bradley et al. (2019) who find that higher levels of analyst coverage are negatively related to work-related injury/illness rates. They attribute the findings to analysts' monitoring hypothesis, which suggests that greater analyst coverage is associated with better external monitoring. While we also link our finding to monitoring, our study explores the monitoring effect of independent board directors, not analysts, on workplace safety.

Our paper also complements the literature on the influence of board independence on corporate social responsibility. Prior literature offers inconclusive findings on this topic. Several studies find that board independence is positively related to CSR performance (e.g., Johnson and Greening, 1999; Webb, 2004; Zhang et al., 2012; Shaukat et al., 2016). Others find that outside directors have a negative or no effect on CSR performance (e.g., Wang and Coffey, 1992; Coffey and Wang, 1998). Our study is different from these studies in that we focus specifically on workplace safety, which is one of the key components of CSR, rather than a basket of various elements. By limiting the scope of study, we attempt to present a more pinpointed finding on a crucial issue that can bear significant consequences.

The rest of the paper is organized as follows. Section 3.2 explains the data and sample used in this study. Section 3.3 discusses the methodology. Section 3.4 shows summary statistics of the variables. Section 3.5 presents the empirical results. And finally, section 3.6 concludes.

3.2 Data and Sample

We extract our data from four data sources: Occupational Safety and Health Administration, Institutional Shareholder Service Directors Compustat, Center for Research in Security Prices, and Execucomp.

We obtain our data on workplace injuries from The Occupational Safety and Health Administration (OSHA). OSHA collected work-related injury and illness data from employers within specific industry and employment size specifications through annual surveys that it conducted from 1996 to 2011.[26] This data collection which is called OSHA Data Initiative (ODI) has information on the number of total cases of injuries and illnesses, number of cases of injuries and illnesses with job transfer or restriction, and number of cases of injuries and illnesses with days away from work for the establishments that provided OSHA with valid data for calendar years 1996 through 2011. ODI also provides establishment-level information, such as establishment unique identifier, SIC industry code, state, number of employers, number of working hours and indicators for unusual events (i.e., disasters, shutdowns and strikes).

We use Institutional Shareholders Service Directors (ISSD) database to acquire data related to individual board directors on the universe of the S&P 1500 companies. We obtain accounting and executive related information from Compustat and Execucomp, respectively.

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[26] Each year, OSHA surveyed approximately 80,000 establishments. It uses a stratified sampling process to have a comprehensive sample that represents various industries within the United States.

Our sample begins in 2002 since OSHA modified its data collection procedure for ODI in that year, and rates for the post years are not comparable with rates for the prior years. We manually match establishments in ODI with firms in Compustat based on the parent companies' names. After merging our data with ISSD and Execucomp, 45,589 establishment-year observations are left. Our sample includes 722 unique firms with 17,174 unique establishments.

3.3 Methodology

3.3.1 Base models

We use the following regression model to measure the effect of board independence on workplace injury and illness rate:

$$TCR_{i,t} = B_0 + B_1(Board\ independence_{i,t}) + \boldsymbol{B_x}(\mathbf{X_{i,t}}) + I_j + Y_t + S_k + \varepsilon_{i,t} \qquad (1)$$

where, the dependent variable, $TCR_{i,t}$, is the number of injuries and illnesses multiplied by 200,000, divided by the number of hours worked by all employees for establishment i in the year t.[27] The explanatory variable of interest, $Board\ independence_{i,t}$, is measured as the proportion of independent directors to total number of directors for parent company of establishment i in the year t. The vector $\mathbf{X_{i,t}}$ represents other controls for Board and CEO, Firm-level and establishment-level attributes including Board size, Board age, Board age sd, Female ratio, Female CEO, CEO duality, CEO turnover, CEO tenure, Log (Assets), Leverage, Asset turnover, M/B, Capex, Cash, Tangibility, Establishment size, Strike,

[27] OSHA define TCR to capture the injury and illness rate.

Seasonal, Shut, and Disaster.[28] The notations I_j, Y_t and S_k denote industry, year and state fixed effects, respectively. Definition of all variables are provided in Appendix A.

In alternative models, we use two other dependent variables as measures of injury and illness rate. The first alternative measure, DART, is the number of injuries and illnesses with days away from work and with job restriction or transfer multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. The second measure, DAFWII, is the number of injuries and illnesses with days away from work multiplied by 200,000, divided by the number of hours worked by all employees the establishment.[29]

Further, to address unobserved heterogeneity among firms and establishments, we include firm and establishment fixed effects in our model, respectively. Firm or establishment fixed effects subsumes the industry and state fixed effects.

3.3.2 Two-stage least square model (2SLS)

In measuring the effect of board independence on workplace safety, there is a potential for endogeneity. It might be the case that reputational concerned independent directors choose to join firms that practice better safety standards. On the other hand, it is also possible that firms with higher injury/illness rate hire independent directors to improve their public image. To tackle the potential endogeneity, we employ a two-stage instrumental variables least square model.

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[28] Our choice of controls is similar to Caskey and Ozel (2017)'s.

[29] OSHA suggests DART and DAFWII as alternative measures of injury and illness rate.

It is well-established in literature that geographical and industry factors affect the governance structure of a firm. There is empirical evidence that firms follow their local and industry peers' governance structures (Glaeser and Scheinkman, 2002; John and Kadyrzhanova, 2010; Anderson et al., 2011; and Balsam et al., 2016). Therefore, we construct two instruments for *Board independence* based on geographical and industry factors. The first instrument, *Industry ratio*, is measured as the proportion of the total number of independent directors in the industry (two-digit SIC code) of the establishment's parent firm to the total number of directors in that industry, excluding the sample firm in question. The second instrument, *County ratio*, is measured as the proportion of the total number of independent directors in the county of the headquarters of establishment's parent firm to the total number of directors in that county, excluding the sample firm in question. The industry-based instrument is suitable since the board structures of the peer firms in one industry are unlikely to affect the workplace safety of the selected (=excluded) firm in the same industry directly, but the factors that motivate the peer firms in the same industry to consider independent directors may also affect the board structure of the selected firm in the same industry. The county-based instrument is also proper because the board structures of the peer firms in a county are unlikely to affect the workplace injuries rate of the selected (=excluded) firm directly, though they might have an impact on the selected firm's board structure in the same county.

In the first stage, we regress *Board independence ratio* on these two instruments and other covariates (see relation (2)), and we predict *Board independence* based on the estimated coefficients. In the second stage, we include the predicted value of *Board independence* in a regression model based on relation (3).

$$Board\ independence_{i,t} = B_0 + B_1(County\ ratio_{i,t}) + B_2(Industry\ ratio_{i,t}) + \mathbf{B_x}(\mathbf{X}_{i,t}) + E_i + Y_t + \delta_{i,t} \quad (2)$$

$$Security\ lit_t = B_0 + B_1(Board\ \widehat{indpendence}_{t-1}) + \mathbf{B_x}(\mathbf{X}_{i,t}) + E_i + Y_t + \varepsilon_{i,t} \quad (3)$$

3.4 Summary Statistics of the Variables

Table 3.1 presents descriptive statistics of all the variables.[30] The average of *Board independence* is 0.78 meaning that, on the average, 78 percent of directors of parent companies of establishment-year observations in our sample are independent. Averages of TCR, DART and DAFWII are 7.47, 5.00 and 2.25, respectively.

<Insert Table 3.1 here>

Table 3.2 provides the number of establishments, and the average of TCR, DART and DAFWII in our sample by industry. While establishments operating in healthcare, medical equipment, pharmaceutical products, and Food products have the highest injury/illness rates in our sample, establishments operating in Business Equipment, and Petroleum and Natural Gas have the lowest injury/illness rates.

<Insert Table 3.2 here>

Figure 3.1 depicts the time trend in injury/illness rates. Injury/illness rates have constantly decreased from 2002 to 2010. There is a slight increase in injury/illness rates in 2011.

[30] To reduce the influence of outliers, we winsorize all variables at 1st and 99th percentiles.

3.5 Empirical Results

3.5.1 Results of Baseline Models

We first estimate our baseline models. Column (1) in Table 3.3 includes the results of the regression model based on relation (1). The coefficient of *board independence* is negative and statistically significant at the 1 percent level. In column (2), we include firm fixed effects. The coefficient of *board independence* remains negative and statistically significant at the 1 percent level. In column (3), we include establishment fixed effects. The coefficient of board independence is still negative and statistically significant at the 1 percent level. These results indicate that as board independence increases, workplace total injury/illness rates decrease.

<Insert Table 3.3 here>

As we explained in section 3.3.1, we use alternative measures for workplace injury/illness rates. The first alternative that we use as a replacement for total injury/illness rates is injury/illness rates with days away, restricted, or transferred. We replace TCR in relation (1) with DART and run the regression. Table 3.4 presents the results. In column (1), we include industry and state fixed effects. The coefficient of *board independence* is negative and statistically significant at the 1 percent level. In column (2), we include firm fixed effects. The coefficient of board independence is still negative and statistically significant at the 1 percent level. In column (3), we include the establishment fixed effect. The coefficient of board independence remains negative and statistically significant at the 1 percent level. These results imply that board independence has a negative effect on injury/illness rates with days away, restricted, or transferred.

<Inset Table 3.4 here>

In a variant (second) alternative, we replace total injury/illness rates with injury/illness rates with days away from work. We substitute TCR in relation (1) with DAFWII and run the regression. Table 3.5 shows the results. In column (1), we include industry and state fixed effects. The coefficient of *board independence* is negative and statistically significant at the 1 percent level. In column (2), we include firm fixed effects. The coefficient of board independence is still negative and statistically significant at the 5 percent level. In column (3), we include establishment fixed effect. The coefficient of board independence remains negative and it is statistically significant at the 1 percent level. These results indicate that board independence has a negative effect on injury/illness rates with days away.

<Insert Table 3.5 here>

3.5.2 Results of 2SLS Model

As we discussed in section 3.3.2, while measuring the effect of board independence on workplace safety, there is a possibility for endogeneity. We run a 2SLS model to cope with the potential endogeneity. In the first stage, we regress board independence on two instruments, *County ratio* and *Industry ratio*, and other covariates based on relation (2). Column (1) in Table 3.6 presents the results. The coefficients of both instruments are positive and statistically significant at the 1 percent level. The F-statistics of 85 shows that these two instruments have a strong first stage and they meet the relevance condition (Nash and Patel, 2019). In the second stage, we regress TCR on predicted *board independence* from the first stage and other covariates based on relation (4). Results are included in

Column (2). The coefficient of $\widehat{Board\ independence}$ is negative and significant at the 1 percent level. In column (3), we replace TCR with DART. The coefficient of $\widehat{Board\ independence}$ is still negative and significant at the 1 percent level. In column (4), we replace TCR with DAFWII. The coefficient of $\widehat{Board\ independence}$ remains negative and significant at the 1 percent level. These results imply that board independence has a negative effect on workplace injury/illness rates even after controlling for endogeneity.

<Insert Table 3.6 here>

We also run the Hansen overidentification test for the two instruments that we use in our models in Columns (2), (3) and (4) of Table 3.6. The Hansen J-statistics of 1.605 (P-value=0.21), 1.989 (P-value=0.17) and 1.805 (P-value=0.16) suggests that the overidentification restrictions are valid for instruments in those models.

3.6 Conclusions

Empirical evidence supports that workplace injury/illness rates affect the firms' performance negatively (Cohn and Wardlaw, 2016). Thus, investment in workplace safety measures and thereby reducing injury/illness rates are expected to benefit shareholders in the long-term. In this paper, we posit that since independent directors have more reputational concerns compared to non-independent directors, they represent shareholders' interests better. As a result, having more independent directors on board will increase the investments in safety measures, thereby reducing workplace injury/illness rates. Measuring the investment amounts of each company in workplace safety measures is not feasible since we do not have access to that information. Therefore, we directly study the effect of board independence on workplace injury/illness rates. Our results show that board independence has a significant negative effect on workplace injury/illness rates. Our findings are robust after considering endogeneity. We thus contribute to the literature on corporate governance effect on CSR. Enhancing workplace safety is considered as one of the most important CSR activities since it substantially contributes to social welfare. We provide the empirical supports for the conflict resolution hypothesis which argues that more effective governance increases firms' CSR activities.

Figure 3.1. Injury/Illness Rate Trends
This figure shows the annual percentage of firms involved in securities litigation in our sample.

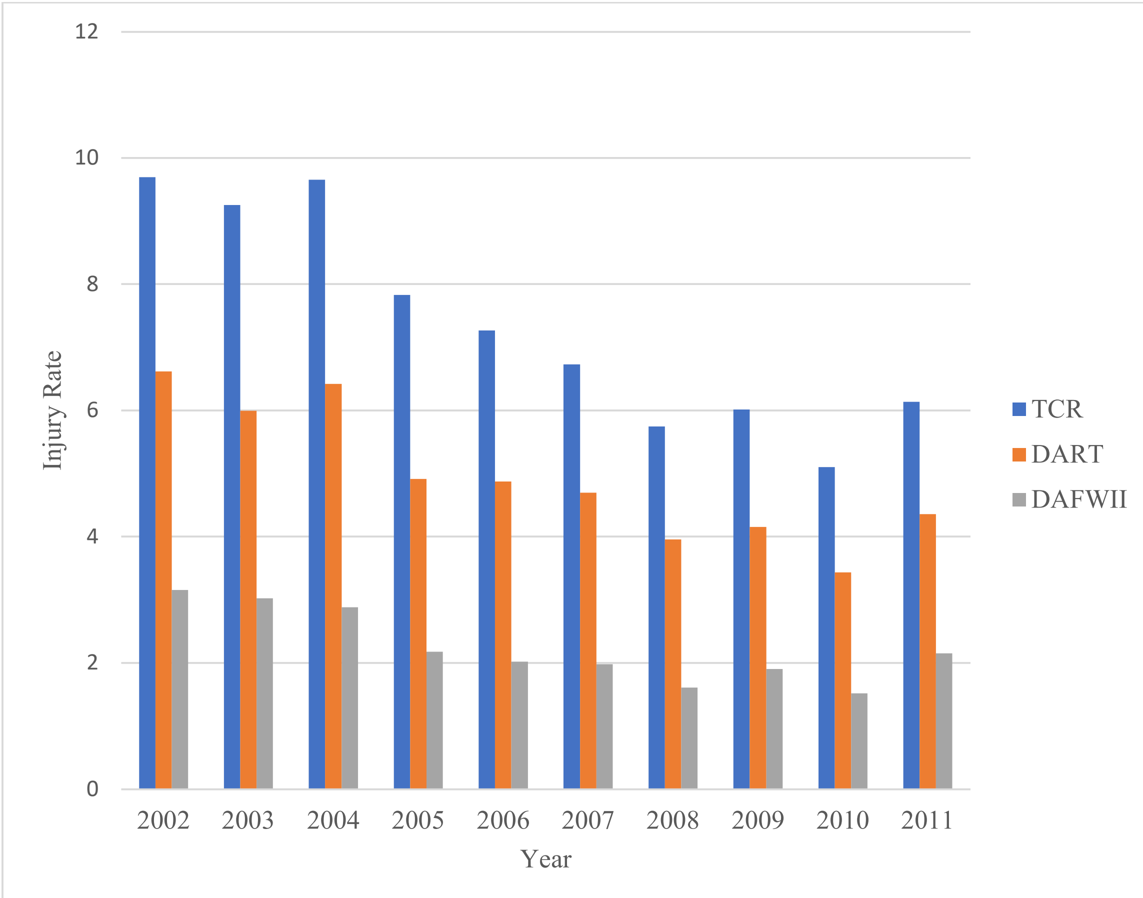

Table 3.1. Summary Statistics

This table summarizes descriptive statistics of the major variables used in the study. N is the number of observations. Mean is the average of establishment-year observations. SD is the standard deviation of establishment-year observations. Min is minimum of establishment-year observations. Max is maximum of establishment-year observations. We provide the definition of each of these variables in Appendix A.

Variables	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
Dependent Variables					
TCR	45,590	7.472	6.265	0.000	29.520
DART	45,590	4.996	4.876	0.000	22.640
DAFWII	45,590	2.249	2.953	0.000	15.340
Board and CEO characteristics					
Board independence	45,590	0.764	0.141	0.000	1.000
Board size	45,590	2.460	0.172	1.609	3.091
Board age	45,590	60.480	3.199	46.290	76.830
Board age sd	45,590	7.498	1.789	1.165	20.680
Female ratio	45,590	0.157	0.090	0.000	0.600
Female CEO	45,590	0.024	0.152	0.000	1.000
CEO duality	45,590	0.449	0.497	0.000	1.000
CEO turnover	45,590	0.089	0.285	0.000	1.000
CEO tenure	45,590	0.487	0.881	0.000	3.738
Firm Characteristics					
Log (Assets)	45,590	9.468	1.430	4.562	11.630
Leverage	45,590	0.239	0.133	0.000	0.764
Asset Turnover	45,590	1.513	0.698	0.202	4.210
M/B	45,590	3.279	2.488	-9.633	24.420
Capex	45,590	0.059	0.036	0.000	0.256
Tangibility	45,590	0.405	0.189	0.066	0.729
Cash	45,590	0.053	0.051	0.000	0.790
Establishment Characteristics					
Establishment size	45,590	4.967	0.930	2.833	7.768
Strike	45,590	0.002	0.043	0.000	1.000
Seasonal	45,590	0.038	0.191	0.000	1.000
Shut	45,590	0.057	0.232	0.000	1.000
Disaster	45,590	0.005	0.071	0.000	1.000

Table 3.2. Average Injury/Illness Rate by Industry

This table provides the average of TCR, DART and DAFWII in establishments in our sample across industries. The industry classification is based on Fama-French 30 industries.

Fama-French Industry Code	**Industry**	**N**	**TCR**	**DART**	**DAFWII**
1	Food Products	3,794	9.49	6.88	2.43
2	Beer & Liquor	40	7.08	5.30	1.74
3	Tobacco Products	30	2.70	1.59	1.39
4	Recreation	142	5.54	3.13	1.10
5	Printing and Publishing	273	3.80	2.25	1.06
6	Consumer Goods	603	6.47	3.79	1.47
7	Apparel	102	5.90	3.61	1.41
8	Healthcare, Medical Equipment, Pharmaceutical Products	3,061	9.59	6.58	2.77
9	Chemicals	1,139	2.51	1.49	0.65
10	Textiles	251	5.06	3.19	1.20
11	Construction and Construction Materials	2,419	5.63	3.14	1.22
12	Steel Works Etc	782	6.30	3.34	1.41
13	Fabricated Products and Machinery	2,348	5.61	2.91	1.14
14	Electrical Equipment	754	4.60	2.40	0.90
15	Automobiles and Trucks	759	6.95	3.74	1.36
16	Aircraft, ships, and railroad equipment	871	4.08	2.00	0.91
17	Precious Metals, Non-Metallic, and Industrial Metal Mining	2	2.87	2.87	2.87
19	Petroleum and Natural Gas	138	1.99	1.37	0.75
21	Communication	50	2.43	1.44	0.91
22	Personal and Business Services	111	6.28	4.34	1.85
23	Business Equipment	1,703	1.91	1.05	0.48
24	Business Supplies and Shipping Containers	2,270	3.15	1.73	0.79
25	Transportation	8,712	10.96	8.16	4.50
26	Wholesale	3,342	8.79	6.50	3.01
27	Retail	13,690	7.36	4.67	1.91
28	Restaraunts, Hotels, Motels	19	6.55	4.72	1.65
30	Everything Else	1,331	5.02	2.96	1.23
	Total	**48,737**	**7.47**	**5.00**	**2.25**

Table 3.3. Board Independence and Injury/Illness Rate - TCR

This table presents results of three regression models, where the dependent variable, *TCR*, is the establishment's number of injuries and illnesses multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. The key explanatory variable, *Board independence*, is the ratio of independent directors to total number of board directors. Column (1) presents results of model which includes industry and state fixed effects. Column (2) presents results of model which includes firm fixed effects. Column (3) presents results of models which includes establishment fixed effects. Year fixed effects are included in all three models. Robust t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	**(2)**	**(3)**
Variables	**TCR**	**TCR**	**TCR**
Board independence	-6.125***	-2.388***	-2.505***
	(-20.73)	(-4.928)	(-5.472)
Board size	-0.955***	-1.085***	-1.163***
	(-4.325)	(-3.003)	(-3.506)
Board age	0.00788	-0.0672***	-0.0760***
	(0.695)	(-3.652)	(-4.498)
Board age sd	-0.213***	-0.0630**	-0.0417
	(-11.76)	(-2.325)	(-1.588)
Female ratio	5.131***	2.999***	4.336***
	(12.22)	(4.183)	(6.607)
Female-CEO	-0.849***	-0.0412	1.354***
	(-4.409)	(-0.0888)	(3.802)
CEO duality	-0.782***	-0.371***	-0.337***
	(-10.18)	(-4.164)	(-4.046)
CEO turnover	0.0522	0.0204	0.0247
	(0.539)	(0.215)	(0.282)
CEO tenure	0.240***	-0.153	-0.359***
	(6.081)	(-1.340)	(-3.476)
Log (Assets)	-0.246***	-0.268*	0.0395
	(-7.572)	(-1.657)	(0.357)
Leverage	0.0587	1.765***	0.600
	(0.212)	(3.634)	(1.301)
Asset turnover	-0.290***	0.0253	0.0391
	(-5.072)	(0.163)	(0.262)
M/B	-0.0533***	-0.0601***	-0.0524***
	(-4.470)	(-3.983)	(-3.724)
Capex	10.00***	1.321	1.202
	(7.582)	(0.756)	(0.693)
Tangibility	0.559*	-2.176***	-4.089***
	(1.789)	(-2.632)	(-5.357)
Cash	-2.140***	-5.877***	-7.454***
	(-3.576)	(-6.486)	(-8.597)
Tangibility	0.291***	0.126***	-0.253*
	(8.900)	(3.716)	(-1.782)
Strike	2.380***	2.678***	1.824**
	(3.075)	(3.568)	(2.346)
Seasonal	0.341**	0.385***	-0.248
	(2.389)	(2.850)	(-1.627)
Shut	0.291**	0.422***	0.115
	(2.570)	(3.863)	(1.020)
Disaster	0.843**	0.396	0.450

	(2.152)	(1.165)	(1.333)
Constant	22.02***	20.62***	21.96***
	(8.032)	(10.24)	(12.58)
Fixed Effects	Year, State & Industry	Year & Firm	Year & Establishment
Adjusted R-squared	0.253	0.354	0.600
Observations	45,589	45,589	45,585

Table 3.4. Board Independence and Injury/Illness Rate - DART

This table presents results of three regression models, where the dependent variable, *DART*, is the establishment's number of injuries and illnesses with days away from work and with job restriction or transfer multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. The key explanatory variable, *Board independence*, is the ratio of independent directors to total number of board directors. Column (1) presents results of model which includes industry and state fixed effects. Column (2) presents results of model which includes firm fixed effects. Column (3) presents results of models which includes establishment fixed effects. Year fixed effects are included in all three models. Robust t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	**(1) DART**	**(2) DART**	**(3) DART**
Board independence	-4.814***	-2.093***	-1.815***
	(-21.33)	(-5.595)	(-5.016)
Board size	-0.549***	-0.735***	-0.772***
	(-3.356)	(-2.641)	(-2.974)
Board age	0.0113	-0.0713***	-0.0864***
	(1.315)	(-5.021)	(-6.492)
Board age sd	-0.156***	0.0105	0.0296
	(-11.70)	(0.504)	(1.484)
Female ratio	4.694***	1.781***	2.185***
	(14.59)	(3.170)	(4.201)
Female CEO	-0.520***	-0.294	0.580**
	(-3.374)	(-1.168)	(2.035)
CEO duality	-0.528***	-0.0891	-0.0523
	(-9.087)	(-1.305)	(-0.810)
CEO turnover	0.352***	0.368***	0.410***
	(4.665)	(4.953)	(5.831)
CEO tenure	0.184***	0.0828	-0.0936
	(6.121)	(0.914)	(-1.150)
Log (Assets)	-0.140***	-0.0688	0.123
	(-5.833)	(-0.553)	(1.454)
Leverage	0.522**	1.640***	1.135***
	(2.521)	(4.335)	(3.078)
Asset turnover	-0.195***	-0.385***	-0.344***
	(-4.361)	(-3.223)	(-2.931)
M/B	-0.0424***	-0.0546***	-0.0454***
	(-4.660)	(-4.499)	(-3.820)
Capex	1.895*	-3.269**	-4.459***
	(1.915)	(-2.364)	(-3.239)
Tangibility	2.051***	-0.403	-2.427***
	(8.473)	(-0.623)	(-3.994)
Cash	-0.0207	-3.782***	-5.194***
	(-0.0452)	(-5.380)	(-7.654)
Establishment Size	0.295***	0.183***	-0.0146
	(11.94)	(6.982)	(-0.143)
Strike	1.571***	1.730***	0.902
	(2.613)	(2.916)	(1.491)
Seasonal	0.271**	0.369***	-0.0844
	(2.409)	(3.355)	(-0.685)
Shut	0.113	0.234***	0.0742
	(1.361)	(2.888)	(0.851)

Disaster	0.673**	0.443	0.435
	(2.178)	(1.625)	(1.466)
Constant	14.11***	13.94***	15.42***
	(6.496)	(8.760)	(11.41)
Fixed Effects	Year, State & Industry	Year & Firm	Year & Establishment
Adjusted R-squared	0.275	0.351	0.582
Observations	45,590	45,590	45,586

Table 3.5. Board Independence and Injury/Illness Rate - DAFWII

This table presents results of three regression models, where the dependent variable, *DAFWII*, is the establishment's number of injuries and illnesses with days away from work multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. The key explanatory variable, *Board independence*, is the ratio of independent directors to total number of board directors. Column (1) presents results of model which includes industry and state fixed effects. Column (2) presents results of model which includes firm fixed effects. Column (3) presents results of models which includes establishment fixed effects. Year fixed effects are included in all three models. Robust t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
Variables	**DAFWII**	**DAFWII**	**DAFWII**
Board independence	-1.683***	-0.522**	-0.748***
	(-12.87)	(-2.264)	(-3.325)
Board size	-0.354***	-0.717***	-0.775***
	(-3.703)	(-4.512)	(-5.074)
Board age	0.0417***	-0.00410	-0.00191
	(8.420)	(-0.493)	(-0.236)
Board age sd	-0.0764***	0.0191	0.0157
	(-9.975)	(1.537)	(1.269)
Female ratio	2.512***	1.125***	1.761***
	(13.13)	(3.256)	(5.457)
Female CEO	-0.121	-0.202	0.124
	(-1.339)	(-1.477)	(0.703)
CEO duality	-0.236***	-0.0126	0.0236
	(-6.949)	(-0.310)	(0.607)
CEO turnover	0.0629	0.0503	0.0371
	(1.445)	(1.124)	(0.878)
CEO tenure	0.0486***	-0.238***	-0.290***
	(2.741)	(-4.168)	(-5.723)
Log (Assets)	-0.0674***	-0.0461	-0.0517
	(-4.802)	(-0.616)	(-0.994)
Leverage	0.296**	-0.0580	-0.439**
	(2.473)	(-0.260)	(-2.022)
Asset turnover	-0.220***	0.0621	0.0948
	(-8.731)	(0.910)	(1.428)
M/B	-0.0196***	-0.0131**	-0.00617
	(-3.752)	(-2.006)	(-0.983)
Capex	4.387***	1.278	0.996
	(7.603)	(1.551)	(1.197)
Tangibility	0.638***	-1.362***	-2.013***
	(4.227)	(-3.457)	(-5.338)
Cash	2.368***	-0.830*	-1.480***
	(8.296)	(-1.959)	(-3.508)
Establishment Size	-0.0673***	-0.116***	-0.0886
	(-4.549)	(-7.419)	(-1.469)
Strike	1.239***	1.413***	0.302
	(2.772)	(3.100)	(0.730)
Seasonal	0.328***	0.436***	0.0920
	(4.836)	(6.114)	(1.270)
Shut	0.0435	0.105**	0.0641
	(0.917)	(2.236)	(1.256)
Disaster	0.540***	0.352*	0.201

	(2.856)	(1.865)	(1.201)
Constant	7.028***	6.474***	7.157***
	(6.533)	(6.904)	(8.577)
Fixed Effects	Year, State & Industry	Year & Firms	Year & Establishment
Adjusted R-squared	0.296	0.325	0.559
Observations	45,590	45,590	45,586

Table 3.6. Board Independence and Injury/Illness Rate - IV approach

This table presents results of two-stage instrumental variables least square models. Column (1) presents results of first stage, where *Board independence* is regressed on two instrumental variables, *Industry ratio* and *County ratio*, and other covariates. *Board independence* is the ratio of independent directors to total number of board directors. *industry ratio* the ratio of total number of independent directors in industry of firm to the total number of directors in that industry after excluding the sample firm in question. *County ratio* the ratio of total number of independent directors in county of firm's headquarter to the total number of directors in that county after excluding the sample firm in question. Column (2) presents results of the regression model, where the dependent variable *TCR*, is the establishment's number of injuries and illnesses multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. Column (3) presents results of the regression model, where the dependent variable *DART*, is the establishment's number of injuries and illnesses with days away from work and with job restriction or transfer multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. Column (4) presents results of the regression model, where the dependent variable *DAFWII*, is the establishment's number of injuries and illnesses with days away from work multiplied by 200,000, divided by the number of hours worked by all employees in the establishment. Predicted value of *Board independence* from the first stage regression in Column (1) is included in the second stage regressions presented in Columns (2), (3) and (4). Robust t-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variables	(1) 1st Stage Board Independence	(2) 2nd Stage TCR	(3) 2nd Stage DART	(3) 2nd Stage DAFWII
Pr Board independence		-7.100***	-3.209***	-2.738***
		(-4.890)	(-2.860)	(-3.751)
Industry ratio	0.278***			
	(28.16)			
County ratio	0.0843***			
	(5.945)			
Board size	0.0346***	-1.331***	-0.982***	-0.575***
	(6.873)	(-5.409)	(-5.303)	(-5.213)
Board age	0.00366***	-0.00595	-0.00631	0.0234***
	(15.46)	(-0.492)	(-0.681)	(4.330)
Board age sd	-0.0204***	-0.0945***	-0.0493**	0.0437***
	(-50.23)	(-2.897)	(-1.971)	(2.811)
Female ratio	-0.222***	3.454***	4.311***	2.783***
	(-28.04)	(6.757)	(10.81)	(11.50)
Female CEO	0.0732***	-1.207***	-0.942***	-0.475***
	(24.06)	(-5.645)	(-5.546)	(-4.668)
CEO duality	0.0547***	-0.353***	-0.350***	-0.457***
	(32.35)	(-2.889)	(-3.739)	(-7.686)
CEO turnover	-0.00304	0.0507	0.235***	0.0373
	(-1.272)	(0.493)	(2.934)	(0.799)
CEO tenure	-0.00958***	0.000175	-0.0178	0.0512**
	(-13.61)	(0.00391)	(-0.517)	(2.431)
Log (Assets)	0.00419***	-0.0771**	-0.0704***	-0.0606***
	(6.067)	(-2.194)	(-2.685)	(-3.962)
Leverage	-0.108***	-0.968***	0.141	0.496***
	(-20.63)	(-2.819)	(0.549)	(3.224)
Asset turnover	-0.00772***	-0.303***	-0.221***	-0.219***

	(-7.230)	(-5.110)	(-4.777)	(-8.306)
M/B	-0.00374***	-0.0466***	-0.0207*	-0.00242
	(-11.50)	(-3.354)	(-1.947)	(-0.391)
Capex	-0.373***	-11.95***	-10.57***	-0.362
	(-15.17)	(-8.677)	(-9.805)	(-0.567)
Tangibility	0.154***	2.635***	3.097***	0.722***
	(32.06)	(7.387)	(11.12)	(4.198)
Cash	0.173***	-2.773***	-0.424	1.336***
	(11.94)	(-4.074)	(-0.806)	(4.039)
Establishment Size	-0.00529***	0.248***	0.284***	-0.0519***
	(-8.258)	(7.061)	(10.56)	(-3.188)
Strike	0.0137	2.522***	1.784***	1.348***
	(0.956)	(3.140)	(2.923)	(2.811)
Seasonal	0.00373	0.943***	0.597***	0.413***
	(1.183)	(6.488)	(5.096)	(5.761)
Shut	0.00246	0.332***	0.132	0.0332
	(0.894)	(2.761)	(1.492)	(0.656)
Disaster	-0.00764	0.370	0.355	0.476**
	(-0.984)	(0.936)	(1.104)	(2.321)
Constant	0.0707***	21.95***	13.56***	4.430***
	(2.858)	(7.379)	(5.745)	(4.308)
Fixed Effects	Year & Establishment	Year & Establishment	Year & Establishment	Year & Establishment
Adjusted R-squared	0.479	0.268	0.294	0.307
Observations	41,173	41,145	41,146	41,146

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APPENDIX

Appendix A. Definitions of variables

Litigation risk in light of board independence, firm complexity, and monitoring costs

Variables	Definitions
$Board\ average\ age\ _{t-1}$	Average age of board's directors at year t-1.
$Board\ age\ diversification\ _{t-1}$	Standard deviation of the ages of all the directors at the end of year t-1.
$Board\ independence\ _{t-1}$	The ratio of independent board directors to total number of board directors at the end of year t-1.
$Board\ Size_{t-1}$	Natural log of one plus number of executive directors, supervisory directors or all of the directors at the end of year t-1.
$Duality_{t-1}$	Equals 1 if CEO is chairman at year t-1, and 0 otherwise.
$Foreign\ Segment_{t-1}$	Equals 1 if firm has a business segment in a foreign country at year t-1, and 0 otherwise.
FPS_{t}	Equals 1 if the firm is in the biotech (SIC codes 2833–2836 and 8731–8734), computer (3570–3577 and 7370–7374), electronics (3600–3674), or retail (5200–5961) industry, and 0 otherwise.
$Size_{t-1}$	Natural log of total assets at the end of year t-1.
$Return_{t-1}$	Market-adjusted 12-month stock return. The accumulation period ends with year t-1 fiscal year-end month
$Return\ skew_{t-1}$	Skewness of the firm's 12-month return for year t-1.
Return sd_{t-1}	Standard deviation of the firm's 12-month return for year t-1.
$\text{Sales growth}_{t-1}$	Year t-1 sales less year t-2 sales scaled by beginning of year t-1 total assets
$Security\ lit_{t}$	Equals 1 if a securities lawsuit filing against the firm occurred during the year t, and 0 otherwise
$Turn\ over_{t-1}$	Trading volume accumulated over the 12-month period ending with the fiscal year-end before lawsuit filing (for sued firms), and year t-1 fiscal year-end month (for non-sued firms) scaled by beginning of year t-1 shares outstanding.
$Firm\ age_{t-1}$	Age is constructed as the number of years the firm has existed on the CRSP database at year t-1.
$Tangibility_{t-1}$	Net total property, plant and equipment at year t-1 scaled by beginning year t-1 total assets.

$Leverage_{t-1}$	Sum of long-term debt and debt in current liabilities at the end of year t-1 divided by total asset at the end of year t-1.
$Capex_{t-1}$	Capital expenditure in year t-1 divided by beginning year t-1 total assets.
$Free\ cash_{t-1}$	Free cash flow calculated as year t-1 operating income before depreciation less total taxes less interest expenses and dividends scaled by beginning of year t-1 total assets.
$Insider\ own_{t-1}$	Total number of shares owned by firm's directors divided by total number of outstanding shares at the end of year t-1.
ROA_{t-1}	Return on assets, defined as year t-1 net income scaled by beginning of year t-1 total assets
$R\&D\ _{t-1}$	Research and development expenses in year t-1 scaled by beginning of year t-1 total assets
$County\ ratio_{t-1}$	The ratio of total number of independent directors in county of firm's headquarter to the total number of directors in that county after excluding the sample firm in question at year t-1.
$Industry\ ratio_{t-1}$	The ratio of total number of independent directors in industry of firm to the total number of directors in that industry after excluding the sample firm in question at year t-1.
$High\ monitoring_{t-1}$	Equals 1 if firm's monitoring index is more than the median of MC index, and otherwise 0.
$High\ complexity_{t-1}$	Equals 1 if firm's complexity index is more than the median of COM index, and otherwise 0.
$MC\ index_{t-1}$	Monitoring cost index. Construction of MC index is explained in section 1.3.3.1.
$COM\ index_{t-1}$	Complexity index. Construction of COM index is explained in section 1.3.3.2.
$TOTAL\ index_{t-1}$	Relative benefits and costs of board independence index. Construction of TOTAL index is explained in section 1.3.3.3.
$Board\ ind * High\ monitoring_{t-1}$	Interaction of $Board\ independence_{t-1}$ and $High\ monitoring_{t-1}$.
$Board\ ind * High\ Complexity_{t-1}$	Interaction of $Board\ independence_{t-1}$ and $High\ Complexity_{t-1}$.
$Board\ ind * MC\ index_{t-1}$	Interaction of $Board\ independence_{t-1}$ and $MC\ index_{t-1}$.
$Board\ ind * COM\ index_{t-1}$	Interaction of $Board\ independence_{t-1}$ and $COM\ index_{t-1}$.
$Board\ ind * TOTAL\ index_{t-1}$	Interaction of $Board\ independence_{t-1}$ and $TOTAL\ index_{t-1}$.

Securities Litigation Risk and Board Gender Diversity

Variables	Definitions
$Accr_t$	Accruals, defined as the change in non-cash current assets minus the change in non-debt current operating liability minus depreciation scaled by beginning-of-year market value of equity defined as common share price times common shares outstanding at beginning of year t.
$Att\ issue_t$	Equals 1 if at least one board director of the firm attends less than 75 percent of annual meetings during year t.
Bad_t	An indicator for bad cash flow news. This variable takes the value of 1 when market-adjusted stock return (Ret) is negative and is 0 otherwise.
$Board\ Size_{t-1}$	Natural log of one plus number of executive directors, supervisory directors or all of the directors at the end of year t-1.
$Board\ age\ diversification_{t-1}$	Standard deviation of the ages of all the directors at the end of year t-1.
$Board\ average\ age_{t-1}$	Average age of board's directors at year t-1.
$Board\ ind_{t-1}$	The ratio of independent board directors to total number of board directors at the end of year t-1.
$CEO\ tenure_{t-1}$	Log of one plus the number of years served by a CEO in current position.
$CEO\ turnover_{t-1}$	Equals 1 if a firm reports a new CEO, and 0 otherwise.
$COM\ index_{t-1}$	Complexity index. Construction of COM index is explained in section 2.3.3.
$Capex_{t-1}$	Capital expenditure in year t-1 divided by beginning year t-1 total assets.
$County\ female\ ratio_{t-1}$	The ratio of total number of female directors in the county of the firm's headquarters to the total number of directors in that county after excluding the sample firm in question at year t-1.
$Duality_{t-1}$	Equals 1 if CEO is chairman at year t-1, and 0 otherwise.
$Earn_t$	Earnings, defined as income before extraordinary items scaled by beginning-of-year market value of equity defined as common share price times common shares outstanding at beginning of year t.
$Female\ CEO_{t-1}$	Equals 1 if firm CEO of the firm is female at year t-1, and 0 otherwise.

$Female\ CFO_{t-1}$	Equals 1 if firm CFO of the firm is female at year t-1, and 0 otherwise.
$Foreign\ Segment_{t-1}$	Equals 1 if firm has a business segment in a foreign country at year t-1, and 0 otherwise.
$Firm\ age_{t}$	Age is constructed as the number of years the firm has existed on the CRSP database at year t.
$Free\ cash_{t-1}$	Free cash flow calculated as year t-1 operating income before depreciation less total taxes less interest expenses and dividends scaled by beginning of year t-1 total assets.
$Female\ ind\ 1_{t-1}$	Equals 1 if firm has only one female independent director at year t-1, and 0 otherwise.
$Female\ ind\ 2_{t-1}$	Equals 1 if firm has only two female independent directors at year t-1, and 0 otherwise.
$Female\ ind\ 3_{t-1}$	Equals 1 if firm has three or more female independent directors at year t-1, and 0 otherwise.
$Female\ ind\ ratio_{t-1}$	The ratio of female independent directors to total number of board directors at the end of year t-1.
$Female\ ind\ ratio * COM\ index_{t-1}$	Interaction of $Female\ ind\ ratio_{t-1}$ and $COM\ index_{t-1}$.
$Female\ ind\ ratio * MC\ index_{t-1}$	Interaction of $Female\ ind\ ratio_{t-1}$ and $MC\ index_{t-1}$.
$Insider\ own_{t-1}$	Total number of shares owned by firm's directors divided by total number of outstanding shares at the end of year t-1.
$Leverage_{t-1}$	Sum of long-term debt and debt in current liabilities at the end of year t-1 divided by total asset at the end of year t-1.
Log(Sale) $_{t}$	Natural log of year t total sales.
$MC\ index_{t-1}$	Monitoring cost index. Construction of MC index is explained in section 2.3.3.
$Male\ connection_{t-1}$	The ratio of male directors who sit on other boards with at least one female director to the total number of male directors at year t-1.
$Male\ ind\ ratio_{t-1}$	The ratio of male independent board directors to the total number of board directors at the end of year t-1.
$Female\ non-ind\ _{t-1}$	Equals 1 if firm has one or more female non-independent directors at year t-1, and 0 otherwise.
$Female\ non-ind\ ratio_{t-1}$	The ratio of female non-independent directors to total number of board directors at the end of year t-1.

Ocf_{t}	Operating cash flows, defined as the difference between earnings (Earn) and accruals (Accr) for year t.
$R\&D_{t-1}$	Research and development expenses in year t-1 scaled by beginning of year t-1 total assets.
Ret_{t}	Market-adjusted stock return, defined as buy-and-hold stock return over the fiscal year (starting from three months after the fiscal year starts) adjusted by the value-weighted stock return over the same period.
$Ret * Bad_{t}$	Interaction of *Bad* and *Ret*.
Return sd_{t-1}	Standard deviation of the firm's 12-month return for year t-1.
$Return\ skew_{t-1}$	Skewness of the firm's 12-month return for year t-1.
$Return_{t-1}$	Market-adjusted 12-month stock return. The accumulation period ends with year t-1 fiscal year-end month.
ROA_{t-1}	Return on assets, defined as year t-1 net income scaled by beginning of year t-1 total assets.
$\text{Sales growth}_{t-1}$	Year t-1 sales less year t-2 sales scaled by beginning of year t-1 total assets.
$Security\ lit_{t}$	Equals 1 if a security lawsuit filing against the firm occurred during the year t, and 0 otherwise.
$Size_{t-1}$	Natural log of total assets at the end of year t-1.
$Tangibility_{t-1}$	Net total property, plant and equipment at year t-1 scaled by beginning year t-1 total assets.
$Tobin's\ Q_{t}$	Ratio of (Market value of equity + Book value of debt) to book value of assets at the end of year t.
$Turn\ over_{t-1}$	Trading volume accumulated over the 12-month period ending with the fiscal year-end before lawsuit filing (for sued firms), and year t-1 fiscal year-end month (for non-sued firms) scaled by beginning of year t-1 shares outstanding.

Board Independence and Workplace Safety

Variables	Definitions
TCR	Establishment's number of injuries and illnesses multiplied by 200,000, divided by the number of hours worked by all employees in the establishment.
DART	Establishment's number of injuries and illnesses with days away from work and with job restriction or transfer multiplied by 200,000, divided by the number of hours worked by all employees in the establishment.
DAFWII	The number of injuries and illnesses with days away from work multiplied by 200,000, divided by the number of hours worked by all employees the establishment.
Board size	Natural log of one plus number of executive directors, supervisory directors or all of the directors.
Board age sd	Standard deviation of the ages of all the directors.
Board age	Average age of board's directors.
Board independence	The ratio of independent board directors to total number of board directors.
Insiders own	Total number of shares owned by firm's directors divided by total number of outstanding shares.
CEO duality	Equals 1 if CEO is chairman, and 0 otherwise.
Female CEO	Equals 1 if firm CEO of the firm is female, and 0 otherwise.
CEO tenure	Log of one plus the number of years served by a CEO in current position.
CEO turnover	Equals 1 if a firm reports a new CEO, and 0 otherwise.
Cash	Firm's cash divided by beginning of year total assets
Log (Assets)	Natural logarithm of firm's beginning of year total assets.
Tangibility	Firm's net property, plant, and equipment divided by total assets, at the beginning of the year.
Leverage	Firm's total short-term and long-term debt divided by total assets, at the beginning of the year.

Asset Turnover	Firm's current year sales divided by beginning total assets.
M/B	Firm's market value of assets divided by book value of assets, at the beginning of the year. Market value of assets equals the sum of market value of equity, book value of total liabilities, and liquidation value of preferred stock minus deferred tax liabilities.
County ratio	The ratio of total number of independent directors in county of firm's headquarter to the total number of directors in that county after excluding the sample firm in question.
Industry ratio	The ratio of total number of independent directors in industry of firm to the total number of directors in that industry after excluding the sample firm in question.
Establishment Size	Natural logarithm of the average number of employees working at the establishment.
Strike	Indicator variable equal to one if there was a strike/lockout in the establishment during the year.
Shut	Indicator variable equal to one if there was a shutdown/layoff in the establishment during the year.
Seasonal	Indicator variable equal to one if the establishment employs seasonal workers.
Disaster	Indicator variable equal to one if the establishment is affected by adverse weather conditions/natural disasters during the year.

Appendix B

Tests of Instrumental Variables

Panel A. Relevance Condition Test

(Univariate Pairwise Correlations)

Instruments	Board Independence	P-value	N
County ratio	0.3982***	0.000	13414
Industry ratio	0.4893***	0.000	13414

Panel B. Relevance Condition Test

(Multivariate Regressions Coefficients and Partial F-stat)

Instruments	Board Independence	P-value	N
County Ratio	0.0369**	0.048	13414
Industry Ratio	0.2820***	0.000	13414
Partial F-Stat (13375,2)	55.91		

Panel C: Exclusion Condition Test

(Over-identification Test)

Chi-square statistic	2.034	0.1538
(Amemiya-Lee-Newey minimum)		

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PUBLICATIONS AND PRESENTATIONS

Hashemi Joo, M., Lawrence, E., Parhizgari, A.M. (2018). *Board gender diversity and litigation risk: Effects of complexity and monitoring costs.* Paper presented at the Academy of Behavioral Finance and Economics 2018 Annual Meeting, Chicago, Illinois.

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Hashemi Joo, M., Lawrence, E., Parhizgari, A.M. (2019). *Board gender diversity and litigation risk: Effects of complexity and monitoring costs.* Paper presented at the Southwestern Finance Association 2019 Annual Meeting, Houston, Texas.

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