Too Much of a Good Thing?
Risk Disclosure and Corporate Innovation

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February 2020

Abstract Using textual analysis of a large sample of 10-K filings for US firms, we find a negative relationship between the extent of risk disclosure and corporate innovation as measured by R&D, patents, and citations. By exploiting two exogenous shocks, we find that it is the increase in the extent of risk disclosure rather than a change in fundamental firm risk that reduces corporate innovation. Further analysis shows that the channel for the innovation decline is due to financial constraints, with risk disclosure having a larger negative impact on innovation among firms with financial constraints. These results are consistent with theoretical predictions that increased disclosure can have unintended consequences for firms making uncertain investments, such as innovation.

Keywords: Risk disclosure, uncertainty, innovation, patents, research and development, 10-K filings, financial constraints, Item 1A

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We gratefully acknowledge Douglas Cumming, Ming Dong, Paolo Fulghieri, Johan Hombert, Mark Kamstra, Laurie Krigman, Lilian Ng, Jerome Taillard, Yelin Zhang, and seminar participants at the 100th Anniversary Accounting Conference at Temple University, American Accounting Association Midwest Region 2018 Meeting, Financial Management Association 2018 Annual Meeting, Midwest Finance Association 2019 Meeting, Paris Financial Management Conference 2018, Southern Finance Association 2018 Annual Meeting, University of Manitoba, University of Saskatchewan, and York University for helpful comments. All remaining errors are our own.

1 Introduction

In 2005 the SEC mandated that firms include a comprehensive risk disclosure section in 10-K filings to inform investors of company risks. While an emerging literature finds that risk disclosures reflect the risk of the underlying firms and are useful to investors, there is a lack of evidence on the operational consequences of mandated risk disclosure for the reporting firms. We examine the impact of mandatory risk disclosure on corporate innovation, one of the most important real corporate activities. We focus on two main questions in this paper: First, does risk disclosure have any impact on corporate innovation—one of the most important corporate real operations? Second, what are the potential channels for risk disclosure to affect corporate innovation?

There is a debate on whether requiring additional risk disclosure affects real firm activities like innovation. On the one hand, corporate disclosure is of vital importance in reducing information asymmetry and cost of capital, and in improving firm performance.[1] The inclusion of a comprehensive risk disclosure section should lead to a better information environment and reduce information asymmetry between managers and shareholders, allowing firms to more readily access the financial market for additional capital and boost investment (e.g. Li, Moshirian, Tian, and Zhang 2017). On the other hand, theoretical models indicate that increased disclosure does not necessarily benefit all firms. While Jorgensen and Kirschenheiter (2003) primarily look at voluntary disclosure, they also model the impact of increased mandatory disclosure. Their partial disclosure equilibrium model shows that managers withhold risk

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[1] See Benston 1973; Healy and Palepu 2001; Verrecchia 2001; Porta et al. 2006; and Lambert, Leuz, and Verrecchia 2007.

disclosure if their firm has highly variable future cash flows. Their model also shows that mandatory risk disclosure increases firms' expected risk premium, which in turn increases the cost of capital and discourages investment. Heinle, Smith and Verrecchia (2018)'s model shows that when expected cash flows are positively skewed (as cash flows from innovation would be), precise disclosure increases the cost of capital and firms would benefit from greater imprecision in disclosure. Thus, mandating additional risk disclosure may actually hurt firms by increasing the precision in their disclosure with adverse impact on the cost of capital and risky investment.

While risks involving firm fundamentals and operating environment, especially with regard to innovations, are relatively easy to identify and disclose, the benefits of innovation are not easily disclosed as they are ex ante uncertain (Aghion and Tirole 1994). Innovations naturally increase firms' information asymmetry and in this scenario, greater imprecision in reporting will benefit firms and investors (Kanodia, Singh, and Spero 2005). For example, if a firm were mandated to provide details for new innovations, this would provide competitors with invaluable information, to the detriment of the disclosing firm. The model in Zhang (2013) shows that while improved disclosure lowers the cost of capital for firms on average, firms with riskier projects (such as innovation) are crowded out as investment capital is redirected to less risky firms.[2] Moreover, other theoretical models argue for limited disclosure from the perspectives of risk-sharing, competition, or coordination considerations.[3] Consequently, the impact of risk disclosure on corporate innovation is an empirical question.

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[2] Kravet and Muslu (2013) find that risk disclosures increase investors' risk perceptions.
[3] See Hirshleifer (1978); Verrecchia (1983); Diamond (1985); Dye (1986); and Morris and Shin (2002, 2004).

We use the ratio of risk keywords scaled by the total number of words in a 10-K filing to measure corporate risk disclosure. Based on the lexical fields from Campbell, Chen, Dhaliwal, Lu, and Steele (2014), we classify risk disclosure in 10-K filings into three main categories: aggregate risk (*Allrisk*), systematic risk (*Syst*), and other risk (*Othrisk*). We find that an increase in the aggregate, systematic, or other risk disclosure is negatively related with future research and development (R&D), number of patents filed, and the number of patent citations. A one standard deviation increase in aggregate risk disclosure in a 10-K filing (0.02) is associated with a decrease of 0.45% in R&D scaled by assets (an average of US$1.58 million in R&D expenditures), a 5.51% decline in the number of patents, and a 7.10% decline in citation-weighted number of patents.[4] The magnitudes are similar when looking at systematic or other disclosed risks.

One key challenge of this research is disentangling the effect of a change in fundamental firm risk from a change in disclosed firm risk, because an increase in fundamental firm risk would result in an increase in disclosed firm risk. Further, there may be many other unobserved variables, such as management conservatism, size, and value, that may affect firm risk disclosure and innovation. To overcome this challenge and other sources of endogeneity, we exploit two exogenous regulatory disclosure changes that the SEC imposed in 2005 and 2008. Prior to 2005, firms were not required to have a risk disclosure section; hence, firms disclosed their risks on a voluntary basis, with some firms having a separate reporting section while others included them

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[4] *Fnpats0* and *TCW0* are log transformed in regression (1) below. Consequently, we need to transform the results back through the following method: Change = exp (coefficient of *Fnpats/TCW* from Table 2 column 2/3 * one standard deviation change in *Allrisk*) – 1. For example Change *TCW* = exp (-3.685*0.02) -1 = 0.0710 or -7.10%.

in existing sections such as in management discussion and analysis. Starting in 2005, however, the SEC mandated that firms include a risk disclosure section called Item 1A. This means that all firms are required to have a discussion of risks that is easily identifiable and comprehensive. Thus, in 2005, there was a mandated change in the extent of disclosed risk without any change in the amount of fundamental firm risk. By examining the 2005 exogenous shock, we find that the mandatory inclusion of the Item 1A risk disclosure section is negatively associated with innovation. After 2005, the negative impact of risk disclosure on R&D, filed patents, and patent citations almost doubles. This regulatory change is unlikely to affect individual firms' fundamental risk, but it affects the extent of risk disclosure, disentangling the effects of fundamental firm risk and mandatory risk disclosure.

A second exogenous regulatory change occurred in 2008 when the SEC expanded the exemption to reporting the Item 1A risk disclosure section. In 2008, the SEC created a category of "smaller reporting companies" which are no longer required to include the Item 1A risk disclosure section in their 10-K filings.[5] Consequently, the risk disclosure for these smaller reporting companies is less identifiable and less comprehensive from their corporate disclosure after 2008. We thus use the 2008 exogenous shock to set up a difference-in-differences (DiD) test to examine the impact of removing the mandatory disclosure requirement. Treated firms, i.e. smaller reporting companies defined as firms with less than $50 million in revenues,[6] showed an

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[5] A firm with revenues less than $50 million or a public float of less than $75 million. See the following SEC link for the formal definition https://www.sec.gov/info/smallbus/src-cdinterps.htm. (last accessed Feb 1, 2020) Previously, only firms with <$25 million in revenue **and** <$25 million in public float were eligible.

[6] Firms with less than $75 million public float are also defined as smaller reporting companies; however, public float data is not available for the sample. The results are similar if firms with market capitalization less than $75 million are defined as smaller reporting companies as well.

increase in innovation after the Item 1A risk disclosure requirement was removed in 2008. In contrast, untreated firms did not experience a rebound in innovation after 2008, and in fact experienced a further decline. Consequently, the negative relationship between risk disclosure and innovation is unlikely to be the result of a change in firms' fundamental risk or unobservable factors, as little has changed between the treatment and control group during this time period.

Finally, there may be some concerns that the previous two regulatory changes may be contaminated with other events such as SOX implementation or the financial crisis. Consequently, we use a regression discontinuity design (RDD) to further identify whether it is the mandated increase in risk disclosure or a change in fundamental firm risk. In this test, we exploit the discontinuity for the risk disclosure exemption after 2008—firms with more than $50 million in revenues must incorporate an Item 1A risk section while smaller firms do not. Firms with revenues near $50 million should have similar fundamental risk, but they differ in the level of risk disclosure as firms above $50 million have to report the Item 1A section. Moreover, this test mitigates concerns with SOX, financial crises, or other concomitant events because firms just above and just below the threshold are exposed to the same events; the only difference between the two is that the former firms are mandated to disclose the Item 1A section.

The discontinuity analysis shows that firms with just above $50 million in revenue experienced significantly lower levels of filed patents and citation-weighted value of patents than firms with just below $50 million in revenue (which were exempt from the risk disclosure section requirement). This further supports the finding that corporate innovation is negatively associated with a firm's mandatory risk disclosure rather than its underlying fundamental risk change.

Interestingly, the results are not due to an overall reduction in investment. In untabulated tests, following the 2005 and 2008 regulatory shocks, capital expenditures scaled by assets (*CAPXA*) shows no significant change. Thus, a mandate for additional risk disclosure only impacts the risky investment, such as R&D, and does not impact other forms of investment, such as capital expenditures, as Zhang (2013) predicts. We examine potential channels underlying the adverse impact of risk disclosure on innovation. Previous studies show that financial constraints reduce innovation.[7] We find that the effect of risk disclosure is magnified among firms with financial constraints. Furthermore, in untabulated tests, mandatory risk disclosure is associated with less issuance of debt and more issuance of equity, suggesting that mandatory risk disclosure likely increases the cost of capital as the capital structure moves to more expensive equity. Consequently, the mechanism appears to be that the market demands a higher return from firms with more disclosed risks, which ultimately crowds out risky innovation projects due to financial constraints.

We examine alternative channels for explaining the negative relationship between risk disclosure and innovation. First, several studies show that regulation changes such as the IFRS adoption reduces information asymmetry.[8] However, our tests show that information asymmetry is unrelated to the risk disclosure-innovation relationship. Second, the adverse impact of risk disclosure on innovation may relate to investment sensitivity and learning. After disclosing risks, managers reduce innovation when they observe that investors are depressing the firm's stock price due to increased perception of the firm's riskiness, or they learn from the market about

[7] See for example Brown et al. (2009) and Brown et al. (2012).
[8] See Byard, Li, Yu (2011); Defond, Hu, Hung, Li (2011); and Horton, Serafeim and Serafeim (2013).

what shareholders dislike.[9] We do not find any support for these two alternative explanations. Finally, we examine whether litigation risk is related to the risk disclosure-innovation relationship. Litigation risk may be associated with both increased disclosure and reduced innovation. However, controlling for litigation risk has no effect on the negative relationship between risk disclosure and innovation.

We run a variety of robustness checks. First, we include traditional firm risk metrics, such as CAPM *Beta* and idiosyncratic volatility (*IVOL*), as controls. If it is a change in the firm's fundamental risk that is causing the negative relationship between risk disclosure and innovation, then traditional risk metrics should absorb the effect. The results are robust to the inclusion of these additional firm risk measures. In addition, the results are not due to accounting conservatism (Khan and Watts 2009; Ahmed and Duellman 2010; Kim and Zhang 2016). In untabulated tests, the negative relationship between risk disclosure and innovation remains after we control for conservatism and an interaction term between conservatism and risk disclosure.

Furthermore, our results are robust to the use of a more restrictive dictionary of risk keywords which are the intersection of risk keywords from Campbell et al. (2014) and Kravet and Muslu (2013). Finally, our results are robust to alternative proxies for readability of 10-K filings, missing R&D values, and orthogonalizing the risk disclosure to underlying firm risks.

Prior literature generally shows positive effects associated with increased disclosure, but more recent research, such as ours, has begun to show that increased disclosure may have unintended consequences for the real corporate activities—in this case, a reduction in corporate

[9] See Loureiro and Taboada (2015).

innovations. However, this does not proscribe mandating more disclosure, but instead means that regulators need to balance the potential benefits from more disclosure with possible side effects that may harm the long-run corporate productivities.

The rest of the paper is as follows. In the next section, we discuss prior research and develop our main hypotheses. Section 3 describes sample and research design. Section 4 reports empirical analyses on the effect of risk disclosure on firm innovation, with robustness tests in Section 4.3. We conclude in Section 5 with a brief summary of the results and implications for practitioners, regulators, and future researchers.

2 Literature and Hypothesis Development

2.1 Literature Review

This study is closely related to the ongoing debate on the consequences of improved financial disclosure. A number of studies show the benefits to firms and capital markets from increased disclosure (Benston 1973; Healy and Palepu 2001; Verrecchia 2001; Porta, Lopez-de-Silanes, and Shleifer 2006; Lambert, Leuz, and Verrecchia 2007). In contrast, some theoretical models suggest that enhanced disclosure may have an unintended adverse impact on the disclosing firms and their investors. Kanodia et al. (2005) show that imprecision in accounting is beneficial when information asymmetry is high; this is exactly the case for innovation, as innovative projects typically have higher information asymmetry than other projects. In addition, Zhang (2013) shows that while enhanced disclosure reduces the cost of capital on average, firms with riskier projects will be revealed as being riskier and will actually suffer an increase in the cost of capital. This increase in cost of capital will in turn reduce firms' investment in risky projects. Innovation generally involves projects with long horizons and uncertain outcomes, which are exactly the types of projects that will be crowded out as a result of increased risk disclosure according to the Zhang (2013) model.

Extant theoretical models show that increased disclosure may have negative effects for the following reasons: 1) disclosing less information may be optimal since patent holders cannot capture all the benefits of the innovation (Hirshleifer 1978); 2) disclosing additional risks may reduce the firm value for current shareholders (Diamond 1985) and increase cost of capital (Smith and Verrecchia 2018); 3) disclosure costs, such as disclosing proprietary information that will help competitors, reduce the optimal amount of disclosure (Verrecchia 1983 and Dye 1986); 4) when some stakeholders have private information, release of additional information may make those private information holders worse off (Morris and Shin 2002, 2004), and 5) the benefits of disclosing more information about innovation accrue mainly to informed institutions, increasing the adverse selection gap between informed and uninformed market participants (Blanco, Garcia, Wehrheim 2018).

Recent empirical studies find that risk disclosures could increase information uncertainty since investors are suddenly exposed to contingencies and risk factors that were previously unknown to them. Kravet and Muslu (2013) find that risk disclosures increase stock return volatility and analyst forecast dispersion. Gao (2010) and Dutta and Nezlobin (2017) show that enhanced disclosure benefits future investors at the cost of current investors who suffer as the value of their investment declines. We provide empirical evidence that more mandatory risk disclosure has the unintended consequence of reducing corporate innovation.

Our paper is closely related to a concurrent work of Avramov et al. (2018), but with the following two major differences. First, whereas Avramov et al. (2018) examine the impact of risk shocks on a wide range of investment and capital structure decisions, our paper focuses on the impact of risk disclosure on innovations, one of the most important real corporate activities. Second, while Avramov et al. (2018) use text-based measures of downside risk to proxy for actual firm risks, our paper focuses on the impact of the disclosure aspect of risk, not the actual amount of risk a firm faces. We use two regulatory changes in risk reporting requirements as quasi-natural experiments to establish a causality effect of risk disclosure on corporate innovation. We also differentiate risk disclosure into different categories of risks.

Another paper related to ours is Li et al. (2017), who show that improved disclosure as proxied by IFRS adoption improves firm innovation. While Li et al. (2017) use IFRS adoption to proxy for an increase of general disclosure, we focus on mandatory risk disclosure. In contrast to their finding that improved disclosure lowers the cost of capital and increases firm innovation, we find that mandating risk disclosure is negatively associated with corporate innovation, consistent with the theoretical prediction of Zhang (2013) that riskier projects are crowded out due to increased risk disclosure.

Our paper contributes to the disclosure literature by examining the impact of text-based risk disclosure on innovation, which is a real corporate activity crucial for firm growth and financial performance.[10] Further, this research also contributes to the literature on innovation and market scrutiny. Gu and Li (2003) find that more information is disclosed when earnings are uncertain. He and Tian (2013) and Bernstein (2015) find that increased market scrutiny from analyst coverage and firms' public listing lead to reduced innovation. In contrast, reduced market

[10] See, for example, Solow (1957); Porter (1991); Grossman and Helpman (1993); Eberhart, Maxwell, and Siddique (2004); Hirshleifer, Hsu, and Li (2013); Hombert and Matray (2018).

attention can improve innovation output. For example, higher anti-takeover provisions result in both more patents and more cited patents (Chemmanur and Tian 2018), and declassifying boards (removing staggered boards) results in declines in firm value, particularly among firms focused on research and innovation (Cremers and Sepe 2017). Our research complements this literature by revealing the unintended adverse consequences of increased risk disclosure on innovation.

2.2 Hypotheses

There are two forces at play in the relationship between risk disclosure and innovation. On the one hand, mandating more risk disclosure should lead to a better information environment and reduce information asymmetry between managers and shareholders. This would allow firms to more readily access the financial market for additional capital and boost investment in innovation (Li et al. 2017). On the other hand, while risks are relatively easy to disclose, the benefits of risky projects are not easily quantified as they are uncertain and may contain confidential information (Kanodia, Sapra, Venugopalan 2004; Kanodia and Sapra 2016). The model in Zhang (2013) shows that firms with riskier projects are crowded out as improved disclosure redirects investment capital to less risky firms.

Moreover, innovation is an irreversible investment that has very uncertain outcomes while the effects are typically seen only in the long term (Holmstrom 1989). Consequently, there is a large real option value to delaying innovation, particularly when facing increased short-term risks. If a firm is faced with greater risks, it becomes more valuable to delay and cancel investment in innovation (Bernanke 1983; Pindyck 1990). Hence, if a manager perceives an increase in risks in the future and truthfully discloses them, innovation activities will likely be cut by risk-averse managers and investors. This leads to the first hypothesis.

Hypothesis 1: Mandating risk disclosure in 10-K filings results in a decrease of corporate innovation.

We are interested in the underlying mechanism for the adverse impact of risk disclosure on innovation. Previous research shows that financial constraints are a large obstacle to investment (Holmstrom and Tirole 1997; Fazzari, Petersen, Blinder, and Poterba 1988; Duchin, Ozbas, and Sensoy 2010). Furthermore, previous studies find that external financing constraints reduce firms' R&D investment (Brown, Fazzari, and Peterson 2009; Brown, Martinsson, and Peterson 2012). Since risk disclosure increases investors' risk perception and makes future investors wary of providing funds to the firm, we expect the impact of risk disclosure on innovation to be greater for firms that are more financially constrained.

Hypothesis 2: The negative impact of risk disclosure on innovation is more pronounced for firms with financial constraints.

3 Data

Our data is primarily the combination of two datasets. First, to measure the innovation output of firms, we use the patent dataset provided by Kogan, Papanikolaou, Seru and Stoffman (2017). This dataset covers annual patents from 1990 to 2010 with such information as the number of patents filed and the truncated-adjusted and citation-weighted number of patents filed. Second, we obtain 10-K filings during 1994 to 2010 from the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database to measure the extent of corporate risk disclosure.

We use financial and stock market data from the CRSP, Compustat and Thomson 13F. We use the Central Index Key (CIK) and filing dates from 10-Ks to match with PERMNO and filing dates from the CRSP-Compustat merged data. We obtain annual financial data from Compustat, and price and trading data from CRSP. To be included in the sample, each firm year must have non-negative total assets (AT) and common equity (CEQ). We obtain institutional ownership data from the Thomson 13F Institutional Holdings database and the number of analysts following the firms from the I/B/E/S database.

Firms that do not file any patents and do not report R&D expense over the entire sample period are excluded from the analysis. This ensures that the sample is limited to firms that innovate.[11] Our final sample includes 43,398 firm years from 1994-2010.

3.1 Measurement of Risk Disclosure

While there are some concerns that risks in the 10-Ks may be "boilerplate" and not representative of the firm's actual risk, previous studies suggest that risk disclosures in the 10-K filings are meaningful since they affect information asymmetry, abnormal returns, trading volume, and firm volatility (Campbell et al. 2014; Kravet and Muslu 2013; Hope, Hu, & Lu 2016; Badia, Barth, Duro, & Ormazabal 2020).

Following Campbell et al. (2014), we exclude 10-Ks with less than 1,000 words, and late filings such as NT 10-K, NT 10-KA, and NTN 10-K. We develop a Java program to parse the 10-K filings to count the keyword frequency in the following risk disclosure categories using the classification in Campbell et al. (2014): aggregate (*Allrisk*), systematic (*Syst*), and other risks (*Othrisk*), which is the average of the legal and regulatory, tax, and financial risks. The aggregate risk (*Allrisk*) is the mean of the *Syst* and *Othrisk* disclosure scores.[12] Campbell et al. (2014) also

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[11] The results are similar if firms that do not report R&D or file any patents over the entire sample period are included.
[12] The results are similar if idiosyncratic risk is included in the aggregate risk.

has a lexical field to measure other idiosyncratic risks (*Idio*); it includes many innovation-related words and is likely to reflect the status quo of a firm's innovation activities.[13] Consequently, idiosyncratic risk is highly related to firm innovation by construction. We use *Idio* as a control variable to account for the propensity of managers to disclose risk—some managers may disclose a great deal of risks while others may disclose few risks in their 10-Ks. To facilitate comparison across firms, we scale keyword count in each risk category by the total number of words in a 10-K filing. We multiply this ratio by 100 for reporting purposes. If there are multiple 10-Ks for the same firm year (for example, there is an addendum), we calculate the average risk scores weighted by document length.

To ensure that our risk disclosure measures are valid, we randomly check 10 sentences for each of the top 50 risk keywords in each risk category. Approximately 85% of the manually checked instances correctly identified risk, which exceeds the 80% standard for textual analysis (Wade, Porac, and Pollac 1997; Humphreys and Wang 2018). In addition, a robustness test in Section 4.3 uses an even stricter risk dictionary requiring the overlap of the Campbell et al. 2014 and the Kravet & Muslu 2013 risk dictionaries.

Because a risk disclosure section was not mandated by the SEC until 2005 and some firms were exempted after 2008, we parse the entire 10-K filings to identify risk disclosure. This means that our risk score is independent of how risk discussion is packaged in the 10-Ks. The risk score is similar regardless of whether the risk disclosures are spread throughout a 10-K filing or concentrated in the risk disclosure section.

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[13] The Campbell et al (2014) dictionary for idiosyncratic risk includes words like "innovation," "intangible," and "intellectual."

3.2 Innovation Inputs and Outputs

We measure innovation by three distinct proxies. To measure corporate innovation inputs, we use R&D expenditures scaled by lagged total assets (*RD*) from Compustat. If R&D expenditures are missing, we set the value to zero. As noted earlier, if a firm reports no R&D expense and files no patents over the entire sample period, it is excluded from the analysis.

To measure the innovation output of firms, we use the patent database provided by Kogan et al. (2017). *Fnpats0* measures the total innovation output of a firm. To incorporate the importance of the patents, we use citation-weighted patent filings (*TCW0*) which weights the patents by the number of citations received: more citations indicate that a patent is more influential. In addition, the *TCW* value adjusts for truncation as patents published later in the sample period have fewer years to accumulate citations.

3.3 Summary Statistics

Table 1 shows the summary statistics for the final sample of more than 40,000 firm years with 7,350 unique firms during 1994–2010. *Fnpats0* and *TCW0*, the two measures of patents prior to the log transformation, are highly skewed with 50% of the firm years in the sample having no patents, despite our restriction of the sample to only firms that have at least one patent or reported R&D expense over the entire sample period. Consequently, to mitigate this right skewness, we use *Fnpats*, which is the natural log of (*Fnpats0* + 1), and *TCW*, which is the natural log of (*TCW0* + 1). Risk disclosure scores are low for less than 1% of the words in the 10-K for *Allrisk* and less than 2% for *Syst*.

Table 1 Panel A shows summary statistics for the full sample and compares the below- versus above-median $Allrisk_{t-1}$ subsamples. We find that firms with above-median *Allrisk* scores invest less in R&D, and have fewer patents and lower citation-weighted patents than below-median firms. Table 1 Panel B shows the yearly distribution of our final sample and the mean of the dependent and independent variables. Note that the declines of risk disclosure in 2006 are due to an increase of 10-K filing length following the implementation of SOX regulations. To test the hypotheses, we focus on the aggregate risks disclosure (*Allrisk*), systematic risk disclosure (*Syst*), and an average of other risk disclosure (*Othrisk*).

4 Research Design and Results

In the baseline analysis, we run the following panel regressions to examine the impact of risk disclosure on future corporate innovation:

$$\{\text{Dependent}_{it}\} = \alpha + \beta\ \{\text{Risk}\}_{it\text{-}1} + \gamma\ \text{RD}_{it/it\text{-}1} + \delta\ \text{X}_{it} + \phi\ \text{Year} + \varpi\ \text{Industry} + \varepsilon \qquad (1)$$

where the dependent variables are R&D expenditures scaled by total assets (RD), the log of the number of patents filed (*Fnpats*), and the log of citation-weighted number of patents (*TCW*). $\{\text{Risk}\}_{it\text{-}1}$ is either *Allrisk*, *Syst*, or *Othrisk* for firm *i* at time *t*-1. X_{it} is a vector of control variables including $RD_{t/t\text{-}1}$,[14] $Idio_{t\text{-}1}$, $BM_{t\text{-}1}$, $LogAT_{t\text{-}1}$, $DA_{t\text{-}1}$, *Firmage*, Herfindahl-Hirschman index (HHI_t), HHI^2_t, $LogAnalyst_t$, IO_t, $CAPXA_t$, $TANG_t$, ROA_t, and $LogLength_t$. We use the lagged value of {Risk} and control variables to mitigate endogeneity concerns by examining the relationship of future innovation with the previous year's independent and control variables. We control for year and Fama-French 49 industry fixed effects and adjust standard errors for clustering at firm and year levels.

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[14] RD_t is used for *Fnpats* and *TCW* regressions to control for any decline in R&D, and $RD_{t\text{-}1}$ is used for the RD_t regression.

We control for a wide variety of firm characteristics. First, as innovation is directly connected to R&D expenditures (*RD*), we control for *RD* for the regressions where *Fnpats* and *TCW* are the dependents and the past level of R&D expenditures (RD_{t-1}) when RD_t is the dependent. Second, we use *BM*, *LogAT*, *DA*, *TANG*, and *ROA* to control for major firm characteristics that may affect innovation (Bernstein 2015; Chemmanur & Tian 2018; Li et al 2017). We include *HHI* and HHI^2 to control for the effects of industry concentration, as increased concentration is associated with less innovation (Nickell 1996). As firm innovation is known to be related to market scrutiny, we control for *LogAnalyst* and *IO*, which are two proxies for market scrutiny (He & Tian 2013). In addition, *Firmage* and *CAPXA* control for any firm life cycle effects that may impact innovation rates (such as younger firms investing more in innovation and older firms investing more in factories to deploy their innovations). Consequently, these variables should control largely for firm characteristics that may affect firm innovation.

Finally, we include *LogLength* to control for the readability of the document, as longer documents are more difficult for investors to understand (Li 2008). Our results are similar if we use an alternative measure of readability: the log of the 10-K file size in megabytes (Loughran and McDonald 2014). Note that the sample includes 43,398 firm years for the R&D regressions, but only 39,204 firm years for the *Fnpats* and *TCW* regressions due to missing patent data.

4.1 Empirical Results

Table 2 shows the baseline results for the relationship between risk disclosure and corporate innovations. For innovation inputs, *RD* declines when the firm is exposed to higher aggregate total risk, systematic risk, or other risk. The results are similar for the two proxies for innovation output: the number of patents filed (*Fnpats*) and truncated adjusted citation-weighted patent counts (*TCW*), even after controlling for the contemporaneous decline in research and development expenditures. These results suggest that both innovation inputs and outputs decline with increased risk disclosure.

Endogeneity is a concern in these regressions as innovation is strongly related to fundamental firm risk and other firm characteristics. For example, size and value are strongly related to innovation; characteristics such as industry concentration, market scrutiny, and firm life cycle may all play a role in the innovation inputs and outputs of a firm. Consequently, we examine exogenous shocks to better identify the relationship between risk disclosure and innovation.

In that vein, we exploit two quasi-natural experiments of regulation changes that represent exogenous shocks to the amount of mandated risk disclosure in 10-K filings—these events change the extent of risk disclosure while not changing fundamental firm risk. The first experiment involves the 2005 SEC requirement for a comprehensive Item 1A risk disclosure section, while the second involves the 2008 SEC relief and simplification for smaller reporting companies, which exempt these firms from disclosing the Item 1A risk disclosure section.[15]

In the first exogenous shock, the SEC required firms to include a comprehensive Item 1A risk disclosure section in their 10-K filings starting in 2005. Consequently, firm risk disclosure became mandatory after 2005.[16] Thus, by examining the impact of risk disclosure before 2005

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[15] https://www.federalregister.gov/documents/2008/01/04/E7-24965/smaller-reporting-company-regulatory-relief-and-simplification (last accessed Feb 1, 2020)

[16] In amanual check of 30 firms, none of the firms had an Item 1A before 2005. Many pre-2005 filings had a section on future risk but these were not as comprehensive as the Item 1A sections.

and after 2005, we will be able to see if mandatory risk disclosure benefits or hurts firm innovation. We add an interaction term between our risk disclosure proxies $\{\text{Risk}\}_{it\text{-}1}$ and a dummy variable *Post2005* indicating the period after 2005 to our benchmark regressions.[17] Note that the year fixed effects, ϕ, automatically obviate the need for a standalone *Post2005* variable, as ϕ is a linear combination of *Post2005*.[18]

As can be seen in Table 3, the coefficients on the proxies for risk disclosure remain significantly negative at the 1% level. The coefficients on the interaction of {*Risk*}***Post2005* are negative and significant at the 5% level, suggesting that there is an even more pronounced adverse impact of mandatory risk disclosure on innovation. After 2005, increased *Allrisk*, *Syst*, and *Othrisk* lead to even larger declines in *RD*, *Fnpats* and *TCW* (columns 1-3, 4-6, 7-9) than prior to 2005. This shows that not only is risk disclosure negatively associated with innovation, but that the implementation of the new risk disclosure section after 2005 makes the adverse impact of risk disclosure on innovation even larger. Our results are consistent with the theoretical models of Jorgensen and Kirschenheiter (2003), Gao (2010), and Dutta and Nezlobin (2017) who predict a reduction in innovation after increased mandatory disclosure. Our results are also consistent with the finding that innovation is negatively impacted by increased exposure to market scrutiny (He and Tian 2013; Bernstein 2015; Chemmanur and Tian 2018).

To further verify these results, we ran a falsification test to see if these results would occur regardless of time period. In untabulated results, we changed the *Post2005* variable to a *Post2000* variable (5 years earlier). We find no significant effect on innovation for the $\{\text{Risk}\}_{it\text{-}1}$

[17] The results are similar if *Post2005* includes year 2005.
[18] The results are similar if a *Post2005* indicator variable is used instead of year fixed effects.

* *Post2000* interaction; consequently, the results in Table 3 are related to the change in risk disclosure requirements in 2005.

4.1.1 Difference-in-Differences (DiD) Test

While Table 3 shows that mandatory risk disclosure is associated with a drop in innovation output, there could be unobservable events driving the results in 2005. Luckily, another exogenous regulatory shock occurred in 2008 that enables a further identification of this effect. In 2008, the SEC created a new category of firm—smaller reporting companies—that were exempted from including the Item 1A risk disclosures in their 10-K filings. This shock provides a natural experiment in which one class of firms (smaller reporting companies) does **not** have to report a risk disclosure section while requirements for other firms are unchanged. This provides an opportunity for us to analyze the results as a DiD regression—*SM* is equivalent to a "Treatment" indicator variable as only smaller reporting companies are treated and *Post2008* is equivalent to an "After" indicator variable as this exemption is only available after 2008.

To ensure that the shock is not contaminated by any other regulatory changes that occurred simultaneously in 2008, we review all the regulations implemented by the SEC in 2007 and 2008 that had an effective date of 2008.[19] All the changes that the SEC implemented are minor technical details (such as amending payment procedures), are focused on out-of-sample firms (such as foreign or private firms), or are not relevant to company reporting (such as new trading rules). Furthermore, the US federal government did not pass any major financial legislation around this time period—the Dodd–Frank Wall Street Reform and Consumer Protection Act and

[19] https://www.sec.gov/rules/final/finalarchive/finalarchive2007.shtml (last accessed Feb 1, 2020)

the Jumpstart Our Business Startups (JOBS) Act were passed in 2010 and 2012, respectively. Consequently, it is unlikely that the results are due to other concurrent financial regulations targeting the same group of firms.

To develop the DiD framework, we include four new interaction variables, $\{\text{Risk}\}_{it\text{-}1}$ * *Post2008*, $\{\text{Risk}\}_{it\text{-}1}$ * *SM*, $\{\text{Risk}\}_{it\text{-}1}$ * *Post2008* * *SM*, and *Post2008* * *SM*. The first variable is an interaction of the risk disclosure variable and *Post2008*, an indicator variable set to 1 if the year is greater than 2008, and 0 otherwise.[20] $\{\text{Risk}\}_{it\text{-}1}$**SM* and $\{\text{Risk}\}_{it\text{-}1}$* *Post2008**SM* are interactions of *SM* and the other variables. *SM* is an indicator variable set to 1 if a firm is a smaller reporting company, and 0 otherwise. *Post2008*SM* is an interaction between *Post2008* and *SM*. As before, the year fixed effects, ϕ, automatically obviate the need for a standalone *Post2008* variable as ϕ is a linear combination of *Post2008*.

Table 4 shows that mandatory risk disclosure results in less innovation as evidenced by a negative coefficient of $\{\text{Risk}\}_{it\text{-}1}$ for all three risk types. To understand the effect of exemption, we examine the interaction coefficients for both *Post2008*SM* and $\{\text{Risk}\}_{it\text{-}1}$* *Post2008*SM* (equivalent to a treatment*after interaction variable). First there is overall evidence that removing the risk disclosure requirement increases innovation in general. In Table 4, the coefficient on *Post2008*SM* is positive in all regressions, and significant when RD is the dependent variable. Removing mandatory risk disclosure for these smaller reporting companies appears to have a positive effect on innovation in general.

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[20] The results are similar if *Post2008* includes year 2008.

Second, the sensitivity to risk disclosure keywords decreases after 2008. The {Risk}$_{it-1}$* *Post2008*SM* coefficients test for the sensitivity of risk disclosure keywords on innovation after 2008 for smaller reporting companies. The coefficients on the three-way interaction terms are significantly positive for nearly all types of risk disclosures when *Fnpats* and *TCW* are the dependent variables. This suggests that the adverse impact of risk disclosure on innovation for smaller reporting companies (as indicated by the interaction term of *Allrisk*SM*) is mitigated when their requirement for a distinct risk disclosure section is lifted. This provides further evidence that risk disclosure is affecting innovation: these smaller reporting companies are not forced to disclose risks in their 10-Ks after 2008 and hence there is less pressure to reduce innovation.

The increase in innovation output is simply not the result of an unobservable effect or an increase in fundamental firm risk. Untreated firms (regular companies) after 2008 ({Risk}$_{it-1}$* *Post2008*) experienced a decline in innovation output, which is the opposite effect of what smaller reporting companies experienced. Furthermore, it is not due to a different impact of risk on smaller firms. The interaction of {Risk}$_{it-1}$**SM* shows a negative effect for *Fnpats* and *TCW* before 2008. That is, smaller firms exposed to risk experience lower innovation than regular firms—the exact opposite effect of the {Risk}$_{it-1}$* *Post2008*SM* variable. In summary, the removal of mandatory risk disclosure has a positive impact on firm innovation.

Further, we run a falsification test to determine whether these results would occur regardless of time period. In untabulated results, we change the *Post2008* variable to a *Post2003* variable (5 years earlier). In this case, there is no significant effect on innovation for the {Risk}$_{it-}$

$_1$* *Post2003*SM* interaction; consequently, the results are related to the reduction in risk disclosure for smaller reporting companies in 2008.

4.1.2 Regression Discontinuity Design (RDD)

The SEC's removal of the risk disclosure requirement for smaller reporting companies provides an opportunity for a regression discontinuity design (RDD), similar to Chava & Roberts 2008 and Iliev 2010, to test the main hypothesis. Smaller reporting companies, proxied by firms with less than $50 million in revenue, are exempt from including a risk disclosure section. Firms just above and below $50 million in revenues will be remarkably similar to one another in terms of firm characteristics and fundamental firm risk; however, once the $50 million revenue threshold is exceeded, the firm must include a risk-disclosure section. This RDD allows us to avoid many of the potential confounding events such as SOX or the financial crisis, as both groups of these firms would be equally affected by those events. Consequently, the major difference between these firms is whether a risk disclosure section was mandated by the SEC. The regressions set up for this RDD is as follows:

$$\{\text{Dependent}\}_{it} = \alpha + \beta_1 \{\text{Risk}\}_{it-1} + \beta_2 \{\text{Risk}\}_{it-1} * SM_{it} + \rho\, SM_{it} + \gamma\, RD_{it-1} + \delta\, X_{it-1} + \phi \text{ Year FE} + \varpi \text{ Ind FE} + \varepsilon \quad (2)$$

One important note is that as long as firms do not have total and complete control over the threshold variable, the RDD assumptions will hold (Lee 2008) and the RDD model will hold. In this case, while firms do have some control over their revenues (Roychowdhury 2006; Stubben 2010), they do not have total control over revenues. Consequently, the RDD model holds even though firms have influence over the threshold variable.

The regressions are similar to Table 4 except that the sample is limited to firms that are near the discontinuity ($42.5 – $57.5 million in sales, or within 15% of the discontinuity) to ensure that the results are focused on the discontinuity and not on other trends in the whole sample; the results are similar for other discontinuities of $47.5 – $52.5 million, $45.0 – $55.0 million, and $40 – $60 million (results untabulated). Furthermore, as this smaller reporting company exemption is only available after 2008 and patent data is only available until 2010, the sample is limited to firm years in 2008, 2009, and 2010. Consequently, no interaction with *Post2008* is needed in the regression.

Table 5 shows further evidence that risk disclosure affects firm innovation output. First, firms that are exempted from including a risk disclosure section in their 10-K filings ({Risk}**SM* interaction) experience greater innovation in terms of both number of patents filed and citation-weighted patents, whether they are facing higher aggregate, systematic, and other risk (columns 2-3, 5-6, and 8-9). Second, it is not a simple firm size effect as *SM* has a negative relationship to *Fnpats* and *TCW*, and the entire sample is below $57.5 million in revenue. Thus, it is not that small firms are inherently more productive in research. In conclusion, the regression discontinuity design mitigates endogeneity concerns and provides further evidence that inclusion of mandatory risk disclosure has a negative impact on firm innovation.

Innovation input, as measured by *RD*, exhibits a nonsignificant positive increase. While directionally correct, the reduced significance is almost certainly due to the extremely reduced discontinuity sample. The discontinuity sample for *RD* has only 158 observations in Table 5 compared to 43,398 observations for Tables 2 through 4. Taken as a whole, Table 5 further provides evidence that removing mandatory risk disclosure can have a positive effect on firm innovation.

4.2 Channels

Brown et al. (2009) and Brown et al. (2012) find that financing is positively linked to innovation, with more financing constraints restraining innovation. Therefore, to test whether risk disclosure reduces innovation through the channel of binding financial constraints, we run the baseline regressions by adding an interaction term between risk disclosure and proxies for financial constraint. Our first proxy for financial constraint is *WWHi*, an indicator variable equal to 1 if a firm is in the top tercile of Whited-Wu scores (Whited and Wu 2006), and 0 otherwise. Our second proxy is *Recession*, an indicator variable equal to 1 if the US economy is in recession as defined by the National Bureau of Economic Research (NBER), and 0 otherwise. Firms are less likely to tap equity and debt markets during recessions, and this is an external financial constraint on firms (Covas and Haan 2012; Aghion et al. 2012; Dawling & Haan 2011). As the *WW* index is constructed using total assets, it is mechanically related to *RD*, which is R&D scaled by assets. Consequently, we do not run the regressions with *RD* as the dependent variable.

Table 6 tests the financial constraint channel. Panel A shows that the coefficient on the interaction of *WWHi* with the three types of risk—aggregate, systemic, and other risk—is negative and significant in five out of six cases. This suggests that financially constrained firms engage in even less innovation with increased risk disclosure. Panel B shows that during recessions, the negative impact of all forms of reported risks on innovation is even more pronounced than in normal economic periods. Table 6 thus suggests that financial constraint is a possible channel for risk disclosure to negatively affect future innovation activities.

To further support the results above, we examine whether firms could overcome their financial constraints by raising external capital. In regressions similar to those in Tables 3-5, we test whether risk disclosure affects external capital raised by the firm. In untabulated results, we find that the adoption of mandatory risk disclosure in 2005 resulted in less debt and more equity being raised, and vice versa in 2008 when risk disclosure rules were relaxed for smaller reporting companies. Consequently, although these firms could still raise capital, they rely on more expensive equity financing rather than less expensive debt financing (Myers 1984). This would likely raise their cost of capital and restrict investment in R&D.

We conduct additional tests to explore whether alternative channels could explain the adverse impact of risk disclosure on innovation. We use the average bid-ask spread of the firm’s share price in the past year as a proxy for information asymmetry and create an indicator variable, *SpreadHi*, that equals 1 if the firm’s average bid-ask spread is above the median bid-ask spread, and 0 otherwise. In untabulated results, we find that while firms with high information asymmetry seem to experience a moderate decline in R&D with increased risk disclosure, these high asymmetry firms do not suffer a decline in patents that is significantly different from that of low asymmetry firms. Overall, information asymmetry does not seem to be the channel for the relationship between innovation and risk disclosure.

To examine whether our results are due to price-investment sensitivity, we run a two-stage analysis. First, we regress capital expenditures scaled by assets (*CAPXA*)[21] on the Tobin's *Q*, inverse total assets, and cash flow. We then use the coefficient for the Tobin's Q as a proxy for

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[21] R&D expenditures were excluded, as including them would create a mechanical relationship between investment sensitivity and *RD*.

the firm's investment sensitivity and create a dummy *Q_CAPXAHi* based on its median value. We then interact *Q_CAPXAHi* with our proxies for risk disclosures to examine whether firms with higher investment sensitivity react differently to risk disclosure. In untabulated results, we find that investment sensitivity has no significant effect on the relationship between risk and innovation.

There is a concern that litigation risk may be an unobservable force driving both increased risk disclosure and decreased innovation. To ensure that the results are not related to litigation risk, we employ two proxies for litigation: an industry-based measure of litigation risk (Francis, Philbrick, and Schipper 1994) and a text-based measure of litigation drawn from 10-K filings. In untabulated results, we find that the negative risk disclosure and innovation relationship is unaffected by litigation risk.

Finally, we examine whether our results are due to the effect of managerial learning. We estimate managerial learning by estimating investment-to-price sensitivity as per Li et al. (2017) and then interact it with our proxies for risk disclosures. In untabulated results, we find that the negative risk disclosure and innovation relationship is not affected by managerial learning.

In conclusion, our results suggest that financial constraint is the most likely channel for risk disclosure to negatively affect future innovations. Proxies for other channels, such as information asymmetry, investment sensitivity, or managerial learning, show no statistically significant effect on the negative relationship between risk disclosure and innovation.

4.3 Robustness Tests

4.3.1 Additional Controls: Beta and Idiosyncratic Volatility

One concern with our findings is that managers or investors are reacting to fundamental firm risks rather than the risk disclosure in the filings. It is possible that managers are actually adjusting their innovation due to increased exposure to systemic risk (as proxied by *Beta*) and idiosyncratic risk (as proxied by idiosyncratic volatility {*IVOL*}) as opposed to the text-based risk disclosures.

We test whether traditional risk measures actually influence innovation by adding to the baseline regression *Beta* and *IVOL*. In untabulated results, we find that *IVOL* shows a negative relationship with *RD* and a positive relationship with patents. Though *Beta* has a positive relationship with *RD*, it has no statistical relationship with patents. In contrast, even after including *Beta* and *IVOL*, the coefficients on the proxies for risk disclosures remain significantly negative. We conclude that the text-based risk measures provide additional information that is not contained within *Beta* and *IVOL,* and that it is not simply the change in fundamental firm risk that is affecting innovation.

4.3.2 Additional Controls: Accounting Conservativism

Another potentially confounding factor is accounting conservatism, which requires an asymmetric verification threshold for gains versus losses: gains require a higher threshold than losses (Basu 1997). Consequently, firms that are conservative in their reporting may naturally disclose more risk in order to be conservative. Furthermore, accounting conservativism may be linked to the firm being conservative in other aspects of the business, such as R&D development, and may thus be collinear with risk disclosure and innovation.

To examine whether our results are driven by accounting conservatisms, we use the proxy for accounting conservatism following Khan and Watts (2009) as an additional control and also include its interaction term with our risk disclosure variables in our regressions.[22] In untabulated tests, we add a control or interaction for conservatism, respectively, as measured by medians and deciles, and find similar results to Table 2. Consequently, accounting conservatism does not seem to have any impact on the relationship between risk disclosure and innovation.

4.3.3 Text Analysis Robustness

To ensure that our program correctly identifies risk disclosure in the 10-K filings, we perform two additional robustness checks. First, we do a manual check of 10 sentences each for the top 50 risk keywords identified in the sample and find that 85% of the time the software correctly identified risk disclosure. In addition to this manual check, we run a more strict textual analysis that only counts a risk keyword if it is in the Campbell et al. (2014) dictionary **and** if the sentence contained an uncertainty-related word from Kravet and Muslu (2013), such as "can/cannot," "could," "may," "might," "risk," or "uncertain." In untabulated results, our main inferences remain qualitatively unchanged.

In addition, there is concern that the risk disclosure measure may be related to 10-K filing tone. We use the lexical dictionary from Loughran and McDonald (2011) to calculate the difference between negative and positive words in a 10-K filing and scale it by the total number of words to proxy for tone. In untabulated results, we found that the results are qualitatively

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[22] This is the annual decile rankings of the three-year average (*t* to *t*-3) of total loss recognition timeliness, which is the speed with which good and bad news is incorporated by the market.

similar after controlling for the tone in Tables 2–4. Consequently, the results are not driven by 10-K filing tone.

4.3.4 Orthogonalized Risk Disclosure

There is a concern that firm characteristics such as company conservatism (as measured by leverage and volatility) and size may be driving risk disclosure. To address this issue, we orthogonalize our risk disclosure metrics to a variety of firm characteristics associated with increased risk disclosure in 10-K filings following Campbell et al. (2014). We run a two-stage regression analysis in which we first regress our proxies for risk disclosure (*Allrisk*, *Syst*, and *OthRisk*) on firm factors and then use the residuals from the first stage regression to predict innovation in the second stage. This process orthogonalizes our risk disclosure measures to the characteristics known to affect firm risk disclosure and ensures that only the unexplained portion of the risk disclosure is used to predict innovation.

The results in Table 7 Panel A show that most of the variables noted in Campbell et al. (2014) are significantly associated with the aggregate, systematic, or other risk disclosures. Nevertheless, even after we use the orthogonalized risk disclosure in Table 7 Panel B, the negative association between risk and innovation largely remains—*Fnpats* and *TCW* are negatively associated with risk in all the specifications. This shows that the negative relationship between risk disclosure and innovation is not caused by the firm characteristics associated with risk disclosure.

4.3.5 Disclosure Opacity

There is a concern that the risk disclosure results are related to the opacity of 10-K filings. For example, managers may try to obfuscate future risks by creating longer filings or using more complicated accounting terms. Consequently, to test whether opacity is related to risk disclosure, we run robustness tests of Table 2 by controlling for opacity including *LogLength*, log of the 10-K file size, and discretionary accruals (calculated using a modified Jones model [Dechow, Sloan, & Sweeney 1995]) and their interaction terms with our risk disclosure metrics.

In untabulated results, the main risk disclosure effect remains; the relationship between risk disclosure and innovation remains negative, regardless of whether a firm has above-median 10-K length, 10-K file size, or discretionary accruals. Consequently, we can rule out that the risk disclosure and innovation relationship is caused by managers obscuring their financial reports.

4.3.6 Capitalized R&D and Future Patents

One concern is that innovation is a multiperiod project and that one year of disclosure of risk will not greatly impact a firm's innovation strategy. Consequently, we examine two alternative specifications to address these concerns.

In the first test, R&D is capitalized (*RDC*) according to Eberhart, Maxwell, and Siddique (2004), i.e., the R&D from the past five years (t-4 to t) is fitted with a constant depreciation rate. The *RDC* variable is then used in lieu of the standard control of *RD* in the main regressions.[23] As Table 8 Panel A shows, even with the inclusion of *RDC*, the results are similar to Table 2, though with less significance due to a smaller sample size. Furthermore, in untabulated tests, the results with *RDC* are qualitatively similar for Tables 3 and 4 even with a slightly smaller sample size.

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[23] Note that RD_t was excluded as a dependent variable as *RDC* incorporates *RD* from year t.

In the second test, the total number of patents from period *t* to *t*+2 are summed to detect the effect of risk disclosure on innovation in the succeeding three-year period. *Fnpats_3* and *TCW_3* sum the number of patents filed and the citation-weighted value of those patents from years *t* to *t*+2.[24] Table 8 Panel B shows that the results for these dependent variables in a longer-term horizon are similar to those in Table 2—the increase in risk disclosure is associated with a corresponding decrease in future innovation over a longer period. In untabulated results, the use of variables *Fnpats_3* and *TCW_3* produces similar results to Tables 3 and 4, showing that the main results are robust to using longer time periods for patents.

4.3.7 Missing R&D

Another potential concern is that firms missing R&D values are not similar to firms with no R&D, as firms may make a conscious choice not to report R&D in their 10-K filings (Koh & Reeb 2015). To account for this possibility, we include two modifications to the regressions run in Table 3. First, a dummy variable indicating whether a firm is missing R&D data (*RDMiss*) is included as a control. Second, if research and development is missing, rather than being set to 0, *RD* is set to the industry average *RD* based on two-digit SIC codes. In untabulated tests, our results remain unchanged.

5 Conclusion

We examine the real impact of a specific mandatory financial disclosure—risk disclosure in 10-K filings—on corporate innovation. Using the risk classifications in Campbell et al. (2014), we find that the extent of risk disclosure in 10-K filings is negatively associated with corporate

[24] This time period was chosen so that there would be at least one year of data following the 2008 exemption of smaller reporting companies from theItem 1A requirement.

innovation. Using the quasi-natural experiments of SEC regulatory changes in 2005 and 2008, we are able to identify the causal effect of risk disclosure on innovation. Further analysis indicates that the adverse impact of risk disclosure on innovation is exacerbated for firms facing financial constraints, as these firms are associated with even larger reductions in innovation than firms without such constraints.

These findings extend the research on information disclosure. First, increased disclosure may not have uniformly positive effects for firms and investors. Increased risk disclosure reduces firm innovation, as managers may not be able to disclose benefits of innovation adequately, and it may result in riskier projects, such as innovation, getting crowded out as investment is redirected to less risky and short-term projects.

This research provides further evidence that firms with less market scrutiny are better able to innovate. Previous studies show that being a public company, increased analyst coverage, and more democratic corporate governance are all associated with less innovation. Our paper adds to the literature by showing that increased mandatory risk disclosure results in less innovation. Our findings are of interest to regulators. Our results suggest that increased disclosure may result in unintended consequences, such as reduced innovation or firms becoming/staying private in order to innovate with reduced scrutiny. Consequently, regulators may need to be more cautious when considering increased mandatory corporate disclosure, particularly risk disclosure.

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Appendix A: Variable Definitions

All variables are winsorized at the 1 and 99th percentiles each year, except for indicator variables and *FirmAge*.

Variable	Definition
Dependent variables	
Fnpats	Log (*Fnpats0* + 1)
Fnpats_3	Cumulative *Fnpats* from years t to t+2
RDC	R&D capitalized over years t-4 to t at the following rate ($RD_t + 0.8\ RD_{t-1} + 0.6\ RD_{t-2} + 0.4\ RD_{t-3} + 0.2\ RD_{t-4}$ (Eberhart, Maxwell, and Siddique 2004)
TCW0	Truncated and citation-weighted patent filings. Patents were truncation-adjusted and citation-weighted by the methodology described in Kogan et al. (2017)
TCW	Log (*TCW0* +1).
TCW_3	Cumulative *TCW* from t to t+2
RD	R&D expenditures as a percentage of lagged total assets. If R&D expenditures are missing, the value is set to 0
Fnpats	Log (*Fnpats0* + 1)
Independent variables	
Allrisk	Aggregate mean of systematic and other risk disclosure scores as measured using the word dictionary from Campbell et al. (2014). Risk disclosure scores are scaled by the total number of words in a 10-K filing.
Syst	Systematic risk disclosure score as measured using the word dictionary from Campbell et al. (2014). Risk disclosure scores are scaled by the total number of words in the 10-K.
Othrisk	Average of risk disclosure scores excluding idiosyncratic and systematic risks as measured using the word dictionary from Campbell et al. (2014). These risks include legal and regulatory, tax, and financial. Risk disclosure scores are scaled by the total number of words in a 10-K filing.
Control variables	
Idio	A control variable using the other idiosyncratic word dictionary from Campbell et al. (2014). The score is scaled by the total number of words in the 10-K.
AT	Total assets in millions of dollars
Beta	*Beta* measured over the financial year using daily data. Firms must be traded on the NASDAQ, AMEX, or NYSE, and have traded for at least 125 trading days over the firm's financial year.
BigN	An indicator variable if a firm uses a Big 4/5 auditor, and zero otherwise
BM	Book equity (CEQ) to market equity (PRCC_F * CSHO) ratio
CAPXA	The capital expenditures (CAPX) of a firm as a percentage of total assets (AT)
DA	Debt (DLTT + DLC) as a percentage of total assets (AT)
DNI	Net income before extraordinary items scaled by market capitalization (t-1)

Firmage	Number of years the firm has been in Compustat
Fnpats0	Number of patents filed during the calendar year
HHI	The Herfindahl-Hirschman Index calculated using firm sales of Compustat firms in the same 2-digit SIC industries
HHI^2	The square of the HHI index to account for any nonlinearities
IO	The percentage of shares owned by institutional investors. Set to 100% maximum. Drawn from Thomson 13F Institutional Holdings database
IVOL	Idiosyncratic volatility measured over the financial year using daily data and the Fama-French 3 factors. We annualized IVOL by multiplying by the square root of the number of trading days. Firms must have > 0 shares, be traded on the NASDAQ, AMEX, or NYSE, have common shares, and have traded for at least 125 trading days over the firm's financial year
KZHi	*KZHi* is an indicator variable set to one if the firm's Kaplan-Zingales score is greater than the sample median for that year, and zero otherwise
LogAT	Log of total assets
LogAnalyst	Log of the number of analysts covering the firm at the end of the financial year. Drawn from the Thomson IBES database
LogLength	The log of the number of words in the firm's 10-K for the most recent fiscal year.
Post[Year]	Indicator variable set to one if the year is > [Year], and zero otherwise
Q	(Market Capitalization – Book Value Common Equity + Book Total Assets) / Book Total Assets
Q_CAPXAHi	An indicator variable set to one if the firm's investment sensitivity is greater than the median, and zero otherwise
Recession	An indicator variable set to one if the US is in recession as defined by the NBER, and zero otherwise
Ret0_12	Cumulative stock return from month t-0 to t-12
ROA	Net income (NI) as a percentage of total assets (AT)
Skew_Ret	The skewness of stock returns over the past financial year using daily data
SM	Indicator variable set to one if the firm has less than $50 million in revenues, and zero otherwise
SpreadHi	An indicator variable set to one if the firm's average bid-ask spread over the past year is above median, and zero otherwise
TANG	Property, Plant, and Equipment (PPENT) as a percentage of total assets (AT)
Turn	Mean daily share turnover over the past year
WWHi	*WWHi* is an indicator variable set to one if the firm's Whited-Wu score is in the top tercile for that year, and zero otherwise

Table 1. Descriptive Statistics

This table reports the summary statistics for the final sample with 43,398 firm-years (7,350 unique firms) during 1994 to 2010. Panel A shows the total sample statistics and the summary statistics for below and above median $AllRisk_{t-1}$ subsamples. Panel B shows the summary statistics by financial year. The variables are defined in Appendix A.

Panel A: Total Sample Statistics

Variable	Mean	STD	Median	Below Median $AllRisk_{t-1}$	Above Median $AllRisk_{t-1}$	t-stat (above-below)
RD	10.5	19.3	3.6	12.4	9.1	-17.63
Fnpats0	12.5	98.5	0.0	12.9	10.6	-2.47
TCW0	29.5	233.8	0.0	30.5	24.8	-2.58
$Allrisk_{t-1}$	0.018	0.020	0.012			
$Syst_{t-1}$	0.050	0.071	0.026			
$Othrisk_{t-1}$	0.012	0.013	0.007			
$Idio_{t-1}$	0.077	0.108	0.042			
AT	3345.7	14077.3	185.2	3334.6	3920.5	4.22
LogAT	5.4	2.4	5.2	5.1	5.7	26.37
BM	0.4	1.5	0.4	0.4	0.4	5.07
DA	21.5	29.5	13.8	21.8	21.6	-0.98
Firmage	19.0	14.7	14.0	18.6	19.3	5.43
HHI	0.1	0.1	0.1	0.1	0.1	6.70
HHI^2	0.0	0.0	0.0	0.0	0.0	2.14
LogAnalyst	1.1	1.1	0.7	1.0	1.1	13.89
IO	37.0	34.6	30.7	33.8	40.1	19.65
CAPXA	5.2	6.8	3.3	5.2	5.4	2.52
Tang	22.3	21.5	15.5	21.3	23.1	9.49
ROA	-11.1	50.4	2.3	-16.9	-7.4	18.43
Beta	0.9	0.6	0.9	0.9	1.0	16.63
IVOL	60.1	37.6	50.5	60.2	58.2	-5.38
LogLength	9.8	0.7	9.8	9.6	9.9	36.64

Panel B: Mean Sample Statistics by Year

Fyear	n	*RD*	*Fnpats0*	*Tcw0*	$Allrisk_{t-1}$	$Syst_{t-1}$	$Othrisk_{t-1}$	$Idio_{t-1}$
1994	532	5.733	18.023	40.938	-	-	-	-
1995	1,821	7.884	10.233	24.386	0.006	0.018	0.004	0.018
1996	3,126	15.749	7.243	17.731	0.007	0.017	0.005	0.026
1997	3,166	12.657	7.295	17.875	0.011	0.026	0.008	0.053
1998	3,076	11.575	9.306	22.716	0.013	0.033	0.009	0.069
1999	3,040	16.012	9.949	24.275	0.018	0.052	0.011	0.106
2000	3,026	16.917	10.356	25.288	0.020	0.061	0.012	0.103
2001	2,858	9.538	11.943	29.355	0.022	0.072	0.012	0.103
2002	2,623	9.252	13.159	32.025	0.023	0.069	0.014	0.110
2003	2,422	9.835	14.595	35.395	0.022	0.064	0.014	0.108
2004	2,386	10.689	13.665	32.648	0.025	0.072	0.015	0.114
2005	2,379	9.928	14.303	33.064	0.025	0.066	0.016	0.114
2006	2,337	11.353	17.262	39.404	0.016	0.044	0.011	0.067
2007	2,307	11.732	14.446	33.419	0.015	0.037	0.011	0.053
2008	2,103	9.767	16.491	37.201	0.016	0.039	0.012	0.051
2009	2,045	9.069	17.840	39.582	0.020	0.057	0.012	0.053
2010	2,012	10.194	18.833	41.783	0.020	0.055	0.013	0.055

Table 2. Risk Disclosure and Innovation

This table reports regression results on the determinants of innovation. When *RD* is the dependent, RD_{t-1} is used as an independent in the regression instead of RD_t. *Firmage*, *HHI*, HHI^2, *logAnalyst*, *IO*, *CAPXA*, *TANG*, *ROA*, *logLength* are all at time *t*, all other independent variables are set at time *t-1* unless otherwise specified. Variables are defined in Appendix A. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
Allrisk	-22.290***	-2.836***	-3.685***						
	(-3.72)	(-2.74)	(-2.99)						
Syst				-5.693***	-0.564**	-0.697**			
				(-4.13)	(-2.08)	(-2.15)			
Othrisk							-17.049*	-3.306***	-4.564***
							(-1.73)	(-2.89)	(-3.22)
Idio	9.758***	0.553***	0.869***	8.791***	0.371**	0.619***	8.224***	0.460***	0.773***
	(6.48)	(2.73)	(3.33)	(6.44)	(2.22)	(2.87)	(5.92)	(2.67)	(3.40)
RD_t/RD_{t-1}	0.001	0.010***	0.014***	0.001	0.010***	0.014***	0.001	0.010***	0.014***
	(1.12)	(8.63)	(8.90)	(1.12)	(8.64)	(8.91)	(1.12)	(8.64)	(8.92)
BM	-0.344	-0.056***	-0.075***	-0.342	-0.056***	-0.075***	-0.349	-0.057***	-0.076***
	(-1.44)	(-2.65)	(-2.66)	(-1.44)	(-2.66)	(-2.67)	(-1.46)	(-2.68)	(-2.69)
LogAT	-1.204***	0.285***	0.342***	-1.206***	0.285***	0.341***	-1.213***	0.285***	0.341***
	(-7.89)	(11.99)	(12.06)	(-7.89)	(11.90)	(11.96)	(-7.93)	(12.00)	(12.07)
Firmage	-0.004	0.008***	0.006***	-0.004	0.008***	0.006***	-0.005	0.008***	0.006***
	(-0.45)	(4.16)	(3.14)	(-0.45)	(4.15)	(3.12)	(-0.50)	(4.13)	(3.10)
DA	-0.026**	-0.002***	-0.003***	-0.026**	-0.002***	-0.003***	-0.026**	-0.002***	-0.003***
	(-2.41)	(-3.07)	(-3.47)	(-2.42)	(-3.13)	(-3.53)	(-2.44)	(-3.10)	(-3.50)
HHI	7.440	-0.470	-0.469	7.587	-0.469	-0.471	7.112	-0.513	-0.524
	(1.48)	(-0.71)	(-0.55)	(1.51)	(-0.70)	(-0.56)	(1.41)	(-0.77)	(-0.61)
HHI^2	-15.545**	0.944	0.970	-15.753**	0.944	0.976	-15.064**	1.009	1.053
	(-2.09)	(0.90)	(0.73)	(-2.11)	(0.90)	(0.73)	(-2.03)	(0.96)	(0.79)
LogAnalyst	1.829***	0.160***	0.211***	1.841***	0.161***	0.214***	1.835***	0.159***	0.211***
	(8.57)	(5.31)	(5.77)	(8.61)	(5.37)	(5.85)	(8.60)	(5.28)	(5.74)
IO	-0.006	-0.004***	-0.004***	-0.006	-0.004***	-0.004***	-0.006	-0.004***	-0.004***
	(-0.96)	(-5.09)	(-4.98)	(-1.00)	(-5.15)	(-5.04)	(-0.98)	(-5.06)	(-4.94)
CAPXA	0.260***	0.004*	0.007***	0.261***	0.004*	0.007***	0.261***	0.004*	0.007***
	(8.56)	(1.78)	(2.81)	(8.58)	(1.84)	(2.87)	(8.56)	(1.79)	(2.83)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
TANG	-0.066***	-0.003***	-0.005***	-0.066***	-0.003***	-0.005***	-0.068***	-0.003***	-0.005***
	(-7.46)	(-2.76)	(-3.44)	(-7.44)	(-2.80)	(-3.48)	(-7.49)	(-2.84)	(-3.52)
ROA	-0.185***	0.000	0.001	-0.185***	0.000	0.001	-0.185***	0.000	0.001
	(-14.50)	(1.12)	(1.37)	(-14.50)	(1.07)	(1.31)	(-14.53)	(1.10)	(1.35)
LogLength	1.037***	0.010	0.038	1.025***	0.007	0.034	1.014***	0.008	0.036
	(4.80)	(0.39)	(1.20)	(4.77)	(0.28)	(1.06)	(4.71)	(0.32)	(1.13)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n	43398	39204	39204	43398	39204	39204	43398	39204	39204
R^2	0.505	0.356	0.336	0.505	0.356	0.336	0.505	0.356	0.336

Table 3. Risk Disclosure and Innovation: 2005 Risk Disclosure Requirement

This table reports regression results on the determinants of innovation. When *RD* is the dependent, RD_{t-1} is used as an independent in the regression instead of RD_t. Post2005 is set to one for financial years post 2005, and 0 otherwise. Variables are defined in Appendix A. Controls are the same as Table 3 and are not reported for brevity. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
Allrisk	-14.311**	-1.755	-2.599**						
	(-2.22)	(-1.62)	(-1.97)						
Allrisk Post2005*	-22.960**	-3.156***	-3.173**						
	(-2.48)	(-2.72)	(-2.31)						
Syst				-4.128**	-0.295	-0.442			
				(-2.45)	(-1.01)	(-1.26)			
Syst Post2005*				-4.565**	-0.785***	-0.743**			
				(-2.12)	(-2.80)	(-2.19)			
Othrisk							-4.497	-2.022*	-3.154**
							(-0.45)	(-1.76)	(-2.15)
Othrisk Post2005*							-36.365**	-3.812**	-4.189**
							(-2.32)	(-2.15)	(-1.96)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n	43398	39204	39204	43398	39204	39204	43398	39204	39204
R^2	0.505	0.357	0.337	0.505	0.356	0.336	0.505	0.356	0.336

Table 4. Risk Disclosure and Innovation: Interaction with 2008 Risk Disclosure Removal for Smaller Reporting Companies

This table reports regression results surrounding the elimination of the risk disclosures for smaller reporting companies in 2008. *Post2008* is a dummy variable equal to one for the period after 2008 and zero otherwise. *SM* is an indicator variable equal to one if the firm meets the smaller company reporting requirements (Revenues less than $50 million). When *RD* is the dependent, RD_{t-1} is used as an independent in the regression instead of RD_t. Variables are defined in Appendix A. Controls are the same as Table 3 and are not reported for brevity. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
Allrisk	-22.051***	-1.897	-2.595*						
	(-3.55)	(-1.56)	(-1.79)						
Allrisk Post2008*	1.909	-3.263**	-3.254**						
	(0.26)	(-2.44)	(-2.06)						
*Allrisk*SM*	12.356	-2.239**	-3.159**						
	(0.82)	(-2.32)	(-2.56)						
*Allrisk*Post2008*SM*	-41.984	6.940***	7.593**						
	(-0.54)	(2.71)	(2.29)						
Syst				-4.619***	-0.423	-0.563			
				(-3.00)	(-1.30)	(-1.46)			
*Syst*Post2008*				0.920	-0.543	-0.428			
				(0.56)	(-1.31)	(-0.87)			
*Syst*SM*				-7.060	-0.513	-0.699*			
				(-1.51)	(-1.54)	(-1.65)			
Syst Post2008*SM*				-21.329	1.346*	1.549			
				(-1.35)	(1.68)	(1.41)			
Othrisk							-27.866***	-1.335	-1.983
							(-3.12)	(-0.98)	(-1.20)
Othrisk Post2008*							-2.328	-6.087***	-7.164***
							(-0.19)	(-5.64)	(-5.59)
*Othrisk*SM*							53.307**	-3.222**	-4.618***
							(2.53)	(-2.48)	(-2.72)
Othrisk Post2008*SM*							16.099	11.099***	12.293***
							(0.14)	(3.53)	(3.18)
SM	0.165	0.254***	0.279***	0.682	0.236***	0.252***	-0.263	0.252***	0.278***
	(0.23)	(3.24)	(2.94)	(0.99)	(3.04)	(2.67)	(-0.38)	(3.24)	(2.98)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
*Post2008*SM*	3.333**	0.144	0.217	3.444***	0.209	0.290	2.754**	0.133	0.198
	(2.39)	(0.93)	(1.22)	(2.99)	(1.31)	(1.58)	(2.01)	(0.92)	(1.18)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n	43398	39204	39204	43398	39204	39204	43398	39204	39204
R^2	0.506	0.362	0.341	0.506	0.361	0.340	0.506	0.361	0.341

Table 5. Risk Disclosure and Innovation: Discontinuity Design

This table examine the effect of the discontinuity of $50 million in revenues (below this threshold, firms are exempt from having to include a risk disclosure section in their 10-K filings) on risk and innovation. The discontinuity sample only includes firms with revenues between $42.5 and $57.5 million and only for years 2008 and after (when the exemption is allowed). *SM* is an indicator variable that is equal to 1 if the firm meets the smaller company reporting requirements (revenues less than $50 million). When *RD* is the dependent, RD_{t-1} is used as an independent in the regression instead of RD_t. Variables are defined in Appendix A. Controls are the same as Table 3 and are not reported for brevity. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
Allrisk	-187.817	-20.727*	-28.136*						
	(-1.62)	(-1.87)	(-1.94)						
*Allrisk*SM*	39.089	27.999***	34.306***						
	(0.23)	(8.60)	(7.78)						
Syst				-48.990	-6.460***	-8.056**			
				(-1.12)	(-2.95)	(-2.34)			
*Syst*SM*				-30.878	4.888***	5.800***			
				(-0.30)	(5.44)	(5.21)			
Othrisk							-194.114***	-15.489*	-23.059**
							(-4.88)	(-1.69)	(-2.22)
*Othrisk*SM*							154.119	31.615***	40.054***
							(1.35)	(9.36)	(7.16)
SM	-4.525***	-0.297***	-0.421***	-3.676***	-0.098	-0.178	-5.497***	-0.280***	-0.411***
	(-8.70)	(-3.37)	(-3.42)	(-9.68)	(-0.73)	(-0.93)	(-11.80)	(-5.32)	(-5.09)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n	158	147	147	158	147	147	158	147	147
R^2	0.6466	0.5168	0.5303	0.6476	0.5158	0.5282	0.6435	0.5104	0.5240

Table 6. Risk Disclosure and Innovation: Interaction with Financial Constraints

This table reports multivariate regressions of innovation and risk with interactions with financial constraint metrics. The dependents are *Fnpats* or *TCW*. *WWHi* is an indicator variable set to one if the firm is in the top tercile of Whited-Wu scores and 0 otherwise. Recession is set to one if the time period falls during an NBER recognized recession, and zero otherwise. Controls are the same as Table 3 and are not reported for brevity. Variables are defined in Appendix A. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Financial Constraint Proxied by WWHi

	(1)	(2)	(3)	(4)	(5)	(6)
	Fnpats	*TCW*	*Fnpats*	*TCW*	*Fnpats*	*TCW*
Allrisk	-2.569**	-3.332***				
	(-2.42)	(-2.66)				
*Allrisk*WWHi*	-1.623**	-2.151**				
	(-2.23)	(-2.32)				
Syst			-0.489*	-0.611*		
			(-1.76)	(-1.87)		
*Syst*WWHi*			-0.620***	-0.702**		
			(-2.74)	(-2.36)		
Othrisk					-2.968**	-4.020***
					(-2.43)	(-2.67)
*Othrisk*WWHi*					-1.252	-2.069
					(-1.15)	(-1.51)
WWHi	0.153***	0.907***	0.153***	0.654***	0.139***	0.780***
	(5.96)	(3.43)	(6.36)	(2.99)	(5.40)	(3.38)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
n	39204	39204	39204	39204	39204	39204
R^2	0.358	0.338	0.358	0.337	0.357	0.337

Panel B: Financial Constraint Proxied by Recession

	(1)	(2)	(3)	(4)	(5)	(6)
	Fnpats	*TCW*	*Fnpats*	*TCW*	*Fnpats*	*TCW*
Allrisk	-2.602***	-3.419***				
	(-2.63)	(-2.87)				
*Allrisk*Recession*	-2.287***	-2.606***				
	(-2.91)	(-4.00)				
Syst			-0.495*	-0.619**		
			(-1.91)	(-1.99)		
*Syst*Recession*			-0.654***	-0.731***		
			(-3.07)	(-3.76)		
Othrisk					-3.089***	-4.308***
					(-2.74)	(-3.04)
*Othrisk*Recession*					-2.133**	-2.520***
					(-2.39)	(-3.03)
Recession	0.001	0.856***	-0.004	0.609***	-0.018***	0.763***
	(0.17)	(3.30)	(-0.35)	(2.84)	(-2.94)	(3.35)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
n	39204	39204	39204	39204	39204	39204
R^2	0.357	0.337	0.356	0.336	0.356	0.336

Table 7. Orthogonalized Risk Disclosure and Innovation

This table reports regressions of innovation and risk orthogonalized to known predictors of risk disclosure. Panel A shows the 1st stage regression results of predictors of risk against the risk scores. Panel B shows the results of the regressions using the residuals from the 1st stage regression in Panel A. When *RD* is the dependent, RD_{t-1} is used as an independent in the regression instead of RD_t. Controls in Panel B are the same as Table 3 and are not reported for brevity. Variables are defined in Appendix A. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: 1st Stage Regressions

	(1)	(2)	(3)
	Allrisk	*Syst*	*OthRisk*
BM	0.001***	0.002***	0.000***
	(5.10)	(5.62)	(3.50)
LogAT	0.001***	0.002***	0.000***
	(8.58)	(10.25)	(5.13)
Ret0_12	0.000	0.000	0.000
	(-1.18)	(-1.25)	(-0.94)
DA	0.000	0.000	0.000*
	(-1.38)	(-0.63)	(-1.95)
IVOL	0.000***	0.000***	0.000***
	(7.31)	(6.31)	(6.97)
Beta	0.002***	0.005***	0.001***
	(11.14)	(9.39)	(11.09)
Skew_Ret	0.000	0.000	0.000*
	(-1.28)	(-0.76)	(-1.80)
Turn	0.000***	0.001**	0.000***
	(2.74)	(2.52)	(2.67)
BigN	0.002***	0.004***	0.002***
	(8.32)	(5.04)	(10.02)
DNI	0.000	0.000	0.000
	(0.49)	(1.31)	(-0.48)
LogAnalyst	0.000**	0.000	0.000***
	(-2.33)	(-0.82)	(-4.08)
IO	0.000***	0.000	0.000***
	(3.45)	(1.12)	(5.33)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
n	40679	40679	40679
R^2	0.125	0.161	0.086

Panel B: Residual Risk Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RD	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*	*RD*	*Fnpats*	*TCW*
Allrisk	-11.870*	-3.642***	-5.045***						
	(-1.82)	(-3.44)	(-4.05)	-3.345**	-0.775**	-1.028***			
Syst				(-2.21)	(-2.46)	(-2.79)			
				-3.345**	-0.775**	-1.028***			
Othrisk							-9.283	-4.014***	-5.850***
							(-0.98)	(-3.47)	(-4.11)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n	34819	34772	34772	34819	34772	34772	34819	34772	34772
R^2	0.643	0.363	0.344	0.643	0.362	0.343	0.643	0.362	0.343

Table 8. Capitalized R&D (t-4 to t) and Sum of Future Patents (t to t+2)

This table reports regressions of innovation and risk disclosure with capitalized R&D (RDC) or cumulative patents. Panel A shows the regressions using capitalized R&D during t-4 to t as a control. Panel B shows the results of the regressions cumulative future patents (Fnpats_3 or TCW_3) from years t to t+2. Other controls are the same as Table 3 and are not reported for brevity. Variables are defined in Appendix A. Robust *t*-statistics adjusted for clustering at firm and year levels are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Capitalized R&D (RDC) (t-4 to t) as Control

	(1)	(2)	(3)	(4)	(5)	(6)
	Fnpats	*TCW*	*Fnpats*	*TCW*	*Fnpats*	*TCW*
Allrisk	-3.081***	-3.957***				
	(-2.89)	(-3.17)				
Syst			-0.624**	-0.765**		
			(-2.27)	(-2.38)		
Othrisk					-3.437***	-4.705***
					(-2.79)	(-3.15)
RDC	0.004***	0.006***	0.004***	0.006***	0.004***	0.006***
	(9.86)	(9.96)	(9.96)	(10.07)	(9.86)	(9.96)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
n	34095	34095	34095	34095	34095	34095
R^2	0.371	0.356	0.371	0.356	0.371	0.355

Panel B: Sum of Future Fnpats & TCW (t to t+2) as Dependent

	(1)	(2)	(3)	(4)	(5)	(6)
	Fnpats_3	*TCW_3*	*Fnpats_3*	*TCW_3*	*Fnpats_3*	*TCW_3*
Allrisk	-10.551***	-13.752***				
	(-3.28)	(-3.61)				
Syst			-1.955**	-2.445**		
			(-2.42)	(-2.56)		
Othrisk					-13.380***	-18.252***
					(-3.61)	(-4.04)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
n	33116	33116	33116	33116	33116	33116
R^2	0.412	0.405	0.411	0.404	0.411	0.404