Financial Disclosure Quality's Role in Fostering Trust: Evidence from the Relation between Disclosure Quality and Innovation

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ABSTRACT

In principle, innovation and financial disclosure have little in common. Yet, previous studies have documented a positive association between financial disclosure quality and innovation. I shed light on this puzzle, by pointing to the fact that high quality disclosure fosters investors' trust, and this trust provides firms the autonomy necessary for innovation. Trust is investors' willingness to be vulnerable to the risk that the firm will fail their expectations in the short-run, i.e., trust is the tolerance for a firm's short-term failure. I too document a positive association between disclosure quality and innovation and demonstrate that it is stronger when disclosure plays a more important role in fostering investor trust, including following events that erode trust and when "generalized trust" is high. Further, a path analysis delineates the impact of disclosure on access to financing, and provides further evidence on the importance of disclosure quality for fostering trust. This study contributes to the literature on the economic role of financial disclosure by highlighting that financial disclosure quality proffers a benefit beyond the standard moral hazard and adverse selection roles.

Keywords: trust, financial disclosure quality, innovation, intangible assets

JEL Classifications: O31, M41, G32.

Data Availability: Data are available from the public sources cited in the text.

I. INTRODUCTION

This paper provides an explanation for the puzzling positive association between financial disclosure quality and innovation (Park 2018; Zhong 2018) by highlighting a benefit of high quality disclosure that receives little attention in the literature. This benefit is that high quality financial disclosure may foster stakeholders' trust.

Although innovation is crucial for firms' long-term growth and survival (Hall 1987; Cefis and Marsili 2005; Hall et al. 2005), information related to it is difficult to convey due to innovation's technical complexity and proprietary value. This challenges financial statements' ability to fulfill their traditional role of providing high quality information to investors (Statement of Financial Accounting Concepts No. 1). To illustrate, management could make the following hypothetical speech:

> I cannot provide you details about my innovation because it is proprietary information (Bhattacharya and Ritter 1985). Even if I did, you are unlikely to understand it because you lack the expertise (Palmon and Yezegel 2012). If you try to monitor me despite your lack of expertise, you only succeed in stifling valuable innovation (Faleye et al. 2011; Brav et al. 2017; Kraft et al. 2018), since innovation requires that I maintain my autonomy (Persaud 2005; Mudambi et al. 2007). Nor can I provide you with reliable information on future cash flows, because innovation is highly risky (Holmstrom 1989). This explains, for example, why Research and Development (R&D) expense is treated as a period cost although it is actually a capital one (Lev and Zarowin 1999; Lev and Gu 2016). However, since innovation requires your financing and noninterference, I ask for your trust and money (Macneil 1981; Mercer 2004).

To sum, the standard adverse selection and moral hazard rational for financial disclosure's positive economic impact does not apply to innovation. However, trust is crucial.

Trusting investors tolerate large information asymmetry and are willing to be vulnerable to the firm's decisions, based upon expectations of positive long-term firm performance (Rousseau et al. 1998).[1] To elaborate, this willingness to be vulnerable is synonymous with the tolerance for short-term failure described in Manso (2011) as necessary for innovation. In Manso's model, it is the board of director's tolerance which is manifested in the manager's compensation and allows for short-term failure. In this paper, it is investor's trust which drives their willingness to provide capital and autonomy for innovation.[2]

Using a sample of 16,294 firm-year observations of firms that apply for patent protection between 1996 and 2010, I document a positive association between financial disclosure quality and innovation.[3] Financial disclosure quality is measured as the principal component of accruals earnings quality and 10-K readability.[4] For innovation, I utilize an objective measure of innovation that is independent of financial disclosure - the number of future utility patent citations (e.g., Griliches et al. 1988; Hall et al. 2001, 2005; Kaplan 2008; Galasso and Simcoe 2011, Aghion et al. 2013; He and Tian 2013; Kerr and Nanda 2015).[5],[6] I find that an increase of one standard deviation in disclosure quality is associated with a 3 percent increase in the number of patent citations. The positive association is confirmed for alternative innovation measures, regression

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[1] Unlike credibility, which is the perceived truthfulness of a specific piece of information, trust is a broader concept of investors' willingness to be vulnerable.

[2] This autonomy may manifest in continued investor support for and noninterference in managers' decisions regarding matters in which investors' have limited (if any) information.

[3] My sample ends in 2010 to avoid truncation issues with future citations.

[4] The results are qualitatively similar if management forecast frequency is added to the disclosure quality measure.

[5] I look at utility patents. Utility patent is the major category of patent application, as distinguished from patents on design and agriculture. Firms in a wide range of industries apply for utility patents.

[6] The literature employs both the number of patent applications and the number of citations. To streamline the paper, I focus on the number of future citations, but as reported in the tables below, my results hold also for the number of patent applications that are eventually granted.

specifications, Granger causality tests, a Heckman self-selection test, and a two-stage least squares analysis to account for endogeneity.

To examine the role of trust, I study two types of events that shock investors' trust: restatements and being Arthur Andersen's client during the Enron scandal. As expected, the positive association is stronger in the period following a trust-eroding restatement. Furthermore, I conduct a difference-in-differences test around Arthur Andersen's unexpected closure in 2001; an exogenous shock to investors' trust in Arthur Andersen's clients. I find that clients that improved their disclosure quality after moving to their new auditor exhibit higher levels of innovation than firms that did not switch auditors in the same time period. Since Enron was the sixth largest firm before the scandal and a "darling" of Wall Street, its fall shook investors' trust considerably.[7] These tests support the notion that disclosure quality rebuilds the trust necessary for innovation.

Next, I look at settings in which I expect the association between disclosure quality and innovation to be stronger if the effect is through building trust. First, in 2000, Regulation Fair Disclosure (Reg FD) increased the importance of public disclosure in building trust by disallowing private communication between firms and analysts. Consistent with disclosure quality strengthening the trust necessary for innovation, cross-sectional tests show that the association between disclosure quality and innovation is stronger in the period after the passage of Reg FD. Additional cross-sectional tests show that the relation is stronger when the firm's stock is less liquid (the firm cannot afford that investors "vote with their feet" and leave), as well as for bigger firms (who are more visible and therefore lower disclosure quality would be more noticeable), and those that choose to report R&D expenditures (which requires more trust than pure period

[7] Pseudo shocks in years before and after the scandal confirm that it is the Enron scandal that drives the results. For both tests, the coefficients of interest are insignificant for pseudo shocks, where the difference-in-differences tests are conducted for the years before and after the actual shocks.

expenses). In these situations, firms may be expected to provide higher quality disclosure, as a failure to do so would erode the trust necessary for innovation.

Next, I consider that trust has double dynamics: willingness to give trust (by investors), and efforts to inspire trust (by the firm). The former is important, because if investors are not open to trusting, there is nothing the firm can do to foster trust. The later component is the mechanism through which a firm's financial disclosure quality may matter for its innovation. Indeed, I find that the relation between disclosure quality and innovation holds when firms report a loss, so that trust is more important to maintain investor support. However, without the first dynamics, the firm's efforts would be in vain (Pevzner et al. 2015). The first component is often referred to as generalized trust and is measured by surveys in which individuals are asked questions similar to "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" (Neville 2012) I utilize a state-level measure of generalized trust and show that the relation between disclosure quality and innovation is stronger in states where generalized trust is higher. The results imply that in states where generalized trust is low, disclosure quality does not increase trust since suspicious investors are less likely to pay attention to disclosure quality and are unwilling to trust regardless of firms' effort to inspire their trust.

Lastly, I consider that the relation between disclosure quality and innovation may be explained by improved access to financing. I conduct a path analysis to separate disclosure quality's direct effect on innovation from its indirect effect through access to financing. Consistent with disclosure quality's role in fostering trust, it has a positive association with the access to financing. In addition, as expected, access to financing increases innovation, since access to financing provides capital for innovation. Interestingly, while the direct effect of disclosure policy on innovation is positive, the indirect effect (that recognizes the cost of financing), is statistically insignificant. The intuition of this test and results is motivated by two questions: Does trust reduce the cost of capital? The answer is yes. Is this relation fully explained by the effect of disclosure policy on cost of capital? No. Since decisions regarding both disclosure quality and innovation are made at the top echelon of the firm, these findings lend further support for the intuition that financial disclosure quality fosters investors' trust in management's myriad decisions.[8]

This study contributes to the budding literature on the relation between innovation and financial disclosure quality.[9] Park (2018) explains the positive relation by financial reporting quality's association with better internal reporting, which helps managers make better decisions and facilitates teamwork. If the mechanism is about internal, rather than external, communication, this raises the question of why the positive relation between disclosure quality and innovation holds only following Reg FD, which was a shock only to external communications. Zhong (2018) explains the relation between disclosure and innovation as transparency reducing managerial career concerns, under the assumption that transparency reduces information asymmetry by providing shareholders with detailed firm-specific information that allows them to separate managerial good decisions from poor results. However, higher financial transparency detects financial failure earlier and hence, should be associated with less innovation given innovation's risky nature and propensity for short-term failure (Manso 2011). Therefore, there is an additional piece in the disclosure policy cum innovation puzzle that is missing here. My study indicates that

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[8] CEO characteristics may also play a role in the relation between financial disclosure quality and innovation, if those characteristics increase both disclosure quality and innovation. However, untabulated path analyses show that the relation between disclosure quality and innovation continues to hold even when CEO characteristics are modeled to determine both disclosure quality and innovation. Furthermore, Park (2018) shows that the relation between disclosure quality and innovation cannot be explained by managerial ability.

[9] In addition to the firm-level studies I discuss here, Brown and Martinsson (2019) conduct a country-level study and document a positive association between the transparent information environment and corporate innovation.

it is more likely that disclosure quality fosters the trust that is important for the rapport between managers and investors in their ongoing relationships.

Second, my study contributes to the literature that links financial disclosure to trust. While a large literature has shown the important role of trust in capital markets in general, relatively little empirical evidence provides insights about how firm managers can increase investors' trust.[10] Existing insights stem from settings where investors' trust in firm managers has been violated by firm managers' decisions (Kim et al. 2004; Elliott et al. 2018; Cianci and Kaplan 2010), and disclosure quality is relevant only in the extreme sense that fraud erodes trust (Amiram et al. 2018).[11] Furthermore, the literature is concerned with the credibility of the financial statements. This credibility depends on the competence and trustworthiness of management (Mercer 2004; Cianci and Kaplan 2010), and that perceived trustworthiness depends on the quality of disclosures (e.g., Barton and Mercer 2005; Elliott et al. 2012; Gordon et al. 2013). However, restricting trust to reporting credibility does not explain why disclosure quality is positively associated with innovation, because, as explained above, reporting provides very little information regarding innovation. My study extends the trust argument to trust in management making the right decisions, as this trust is crucial for innovation. My results are consistent with disclosure quality fostering trust that promotes innovation.

[10] The two types of trust are generalized and personalized. Bottazzi et al. (2016, 2284) explain that "generalized trust pertains to the preconceptions that people of one identifiable group have for people from another identifiable group. Personalized trust, on the other hand, concerns an evolving relationship between two specific agents." While empirical papers often focus on generalized trust by looking at country-level investors' trust in the market, this study investigates personalized trust by looking at firm-level trust inspired by financial statements.

[11] The existing accounting literature on trust focuses on mitigating negative investor reaction to bad news. In my paper, I expand on trust's contribution to the firm by showing that trust can also contribute to a firm's investment decisions.

II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Innovation is the process of creating something new and useful, and it confers a strategic advantage over competitors and determines the firm's growth and long-term survival (e.g., Chan et al. 1990; Hall 1987, 2009; Griliches 1990; Banbury and Mitchell 1995; Roberts 1999; Cefis and Marsili 2005; Hall et al. 2005; Farre-Mensa et al. 2017; Kogan et al. 2017).

Innovation has certain characteristics that distinguish it from other investment decisions. Innovation is a long-term, uncertain process with a high chance of failure (Holmstrom 1989). Consequently, investment in innovation is highly risky (Hall 2009)[12] and requires a focus on long-term performance and a tolerance for short-term failure (Manso 2011; Ederer and Manso 2013; Baranchuk et al. 2014; Tian and Wang 2014). Investment in innovation is an internal decision that is very difficult to observe. Innovation involves high proprietary costs, high complexity, and highly uncertain outcomes (Bhattacharya and Ritter 1983; Holmstrom 1989; Hull and Lio 2006; Kerr and Nanda 2015). These characteristics make it very difficult for financial disclosure to provide high quality information regarding innovation.

The Connection between Disclosure Quality and Innovation

Innovation activities are not only associated with a high information asymmetry between managers and investors, but they also involve a higher degree of risk and unpredictability, which impairs financial disclosures' ability to convey meaningful information about the firm's value and future performance (Lev and Zarowin 1999; Lev and Gu 2016). For example, research and

[12] Because investment in innovation is highly risky, some studies treat R&D intensity as a control for risk (Huddart and Ke 2007; Custódio and Metzger 2013).

development (R&D) expenses are uninformative regarding realized innovation performance (Potepa and Welch 2017).[13]

The two traditional roles of disclosure are informativeness and stewardship (Beyer et al. 2010). Informativeness is the requirement outlined in SFAC No. 1 which asserts that financial disclosure reduces *adverse selection* by allowing investors to form a reasonable estimation of future cash flows. In regard to the meager information about innovation that is provided by R&D expense, Cohen et al. (2013) offer evidence that the market misprices the informational content of current R&D intensity that is deducted from the recorded past financial success. This implies that adverse selection is not eliminated. Stewardship is the requirement in SFAC No. 1 that financial disclosure should reduce *moral hazard* by providing information to monitor management. Monitoring the innovation decision requires expertise and information that is often neither communicated due to its high proprietary costs (Bhattacharya and Ritter 1983), nor properly processed due to its highly uncertain nature (Hirshleifer et al. 2013). More importantly, monitoring may reduce innovation, as evidenced by monitoring of management through intense board monitoring (Faleye et al. 2011), analysts coverage (He and Tian 2013), shareholder litigation (Lin, Liu, and Manso 2020), shareholder intervention (Qi 2016), anti-takeover measures (Fang et al. 2014; Sapra et al. 2014; Chemmanur and Tian 2018), and hedge fund activism (Brav et al. 2017). Similarly, creativity requires a certain level of autonomy, even at the corporate level (Persaud 2005; Mudambi et al. 2007).[14] Since the informational roles of financial accounting

[13] Although FAS 2 requires disclosing R&D expenditures, firms exercise considerable discretion in whether to report and what to include in them, so that they are a poor reflection of innovation (Koh and Reeb 2015; Potepa and Welch 2017).

[14] One of the determinants of innovation is creativity, and creativity requires autonomy (Amabile 1979). Since intrinsic motives drive creativity, careful selection of CEOs with the correct intrinsic motives, based on subjective evaluations that are not specific to the innovation output, are more important to innovation than monitoring (Grabner

(informativeness and stewardship) do not apply to corporate innovation, innovation provides a good setting for studying the role of disclosure quality in fostering investor trust. Although trust itself is unobservable, its existence may be inferred in a setting in which it plays a more central role in decision making, such as when information asymmetry is high (Pevzner et al. 2015).

This current study focuses on the role of disclosure in creating investor trust in the firm. Rousseau et al. (1998) asserts that "[t]rust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" (395). The unobservability of the myriad of decisions that involve innovation increases information asymmetry and makes investors more vulnerable. This vulnerability creates a demand for trust—not just trust in the credibility of the accounting numbers, but trust in management itself. So far, the accounting literature provides experimental evidence that this trust can reduce the negative reaction to bad news (Barton and Mercer 2005; Cianci and Kaplan 2010; Elliott et al. 2012; Elliott et al. 2018).[15] In this paper, I show that trust can also affect firms' investment decisions by enabling firms to innovate. In general, trust is important since the firm is a nexus of contracts (Watts and Zimmerman 1986). Trust is a substantial factor when it comes to the firm's relationship with its investors, since the contract is a *relational* contract, where the firm has ongoing contracting with its investors' base (as reflected by the accounting "going concern" assumption). To emphasize, without trust, there is no contract (Macneil 1981).[16] Specifically, in

2014; Grabner and Speckbacher 2016). The reliance on subjective evaluations of non-task-related performance is consistent with the need for trust.

[15] Empirically, Gordon et al. (2013) show that a greater amount of pre-restatement disclosure is associated with a less negative market reaction, which they interpret as indicating that the disclosure established investor trust.

[16] The understanding that restoring investors' trust is vital to a firm's survival is evident in regulators' reactions to the accounting scandals at the beginning of the century. Following these scandals, the Sarbanes Oxley Act of 2002 was enacted in order to restore investors' trust in corporate America.

regard to the relationship between disclosure quality and innovation, the properties of financial disclosure that are incompatible with the nature of innovation are valuable for building trust.

Trust enables firms to innovate because of innovation's unique nature that requires autonomy and the freedom to be creative.[17] Persaud (2005, 424) conducted a survey of multinational corporations and finds that greater autonomy awarded to subsidiaries positively impacts R&D:

> [t]he positive relationship between autonomy and innovative proficiency synergy indicates that those R&D units that are free to make decisions regarding their project portfolios, human resources, and collaborative partners are likely to be more proficient at generating and exploiting new and successful innovations. […] Hence, the fear that autonomous units will pursue their own agenda is unjustified, thereby weakening the case for HQ to micromanage R&D units.

Similarly, Mudambi et al. (2007) document that subsidiary self-determination over inputs and outputs is positively associated with patent citations. They reason that self-determination increases managers' intrinsic motivation and empowers them to innovate. These subsidiary-level findings are consistent with the firm-level findings described above that monitoring may stifle innovation. The means to reduce micro-management, and unnecessary monitoring by external stake-holders, is to build trust. Therefore, a firm with better disclosure quality may be more innovative because disclosure quality builds the investors' trust, which empowers firms to innovate.

[17] For other types of investment decisions, disclosure quality may have a positive association with investment efficiency because high external disclosure quality may indicate higher quality internal information processing, which may result in better decision-making. This is unlikely to be the case with regards to innovation, where high quality internal information may be useful for collaboration that supports innovation, but independent thinking plays the main role.

To emphasize, Manso (2011) shows that innovation requires a tolerance for failure. This tolerance for failure is synonymous with a willingness to be vulnerable. Therefore, Manso (2011) supports the hypothesis that innovation requires trust. However, while Manso focuses on the board of directors' trust in management as manifested in compensation contracts that allow for short-term failure, this paper focuses on investors' trust.

Alternatively, higher disclosure quality may decrease innovation. Balakrishnan et al. (2014) show that firms increase disclosure quality to increase stock liquidity. However, liquidity impedes corporate innovation by putting more pressure on the firm to meet short-term performance measures, through both an associated increase in quasi-indexed institutional investors and an increase in the threat of a hostile takeover (Fang et al. 2014). Therefore, higher disclosure quality could potentially decrease innovation.

I posit the following hypothesis in the alternative form:

H1: Financial disclosure quality has a positive association with innovation.

This relation between disclosure quality and innovation is expected to be stronger when financial disclosure plays a more significant role in building trust and when low disclosure quality is more likely to erode investors' trust. Specifically, the relation should be stronger following the restrictions on private communication with analysts and investors and when firms' stock is less liquid, and it should be stronger for larger firms, and those that report R&D expenditures.

When firms cannot convey sensitive information through private channels, it becomes more important for investors and analysts to trust them without this information. The SEC suppressed the "whispers and winks" game between firms and analysts and institutional shareholders (Levitt 1998) by promulgating Reg FD in October 2000. Koch et al. (2013), Leuz and Wysocki (2016), and Ahmed and Schneible (2007) assert that Reg FD had a "chilling effect" on the flow of information to investors of highly technological firms. Consequently, Reg FD is expected to increase the importance of financial disclosure quality to building investor trust that enables firms to innovate.

Furthermore, when a firm's stock is illiquid it is more vulnerable to its relationship with its existing investors, so that financial disclosure quality is more important for maintaining their trust.

Similarly, when firms are more visible and report R&D expenditures, investors may expect high quality disclosure, so that failure to provide it would erode trust. Similarly, information asymmetry is lower, investors may be more sensitive to the firm's financial disclosure quality. For example, firms with higher visibility may need to maintain higher disclosure quality to maintain investors' trust. Therefore in these situations, disclosure quality may be expected to have a stronger association with innovation.

Lastly, disclosure quality would have a stronger association with innovation when investors are willing to be trusting when firms are more trust-worthy. Trust is a two-way street: while firms' may earn trust by providing higher quality disclosure, trust cannot be built without investors' openness to the idea that firms may be trust-worthy (Guiso et al. 2008; Pevzner et al. 2015). This openness to the idea the other may be worthy of trust is called generalized trust, and is inherent to investors regardless of firms' actions. Pevzner et al. (2015) demonstrate that generalized trust has a stronger association with market response to earnings announcements for innovative firms. Only when generalized trust is high enough, do investors differentiate among financial disclosure qualities to decide which firms are more trust-worthy and therefore worthy of the autonomy required to innovate.

The discussion above may be summarized in the following hypothesis (in the alternative form):

H2: The positive association between disclosure quality and innovation is stronger when financial disclosure quality plays a more significant role in building trust.

III. RESEARCH DESIGN

Main Variables

Innovation

Innovation is a process that creates new ideas, devices, or methods, and this process often generates patents. Therefore, the common proxy for innovation is based on patent data (e.g., Griliches et al. 1988; Hall et al. 2001; Kaplan 2008; He and Tian 2013). Patents are a good proxy because they are granted only after verification of the non-obvious novelty by qualified government officers at the United States Patent and Trademark Office (USPTO) (Sections 102 and 103 of Title 35 of the United States Code).[18] The non-obvious requirement precludes patenting of something new when a person with the relevant technical background can invent the innovation independently.

Innovation quality is often measured by the number of annual patent citations (Hall et al. 2005; He and Tian 2013). The number of patent applications should capture a firm's intent and effort to innovate, while future citations of these patents likely indicate that the firm is actually being innovative. The connection between patent citations and successful innovation is also evident from the positive correlation between firm value and the citations. Hall et al. (2005) find

[18] For a recent study that demonstrates the importance of the USPTO to corporate innovation, see Jia and Tian (2018).

that an extra citation per patent boosts market value by 3 percent. Therefore, I focus on the qualitative measure of the number of patent citations.[19]

The focus of my work is on innovation, thus defined as a process for creating something new. Therefore, my variable of interest is the internal decision-making that is crucial for innovation. These decisions are unobservable, and they include decisions both at the start of the innovative project, such as the choice of project, and during the life of the project, such as continued funding, corporate culture, and employee incentives. Since these decisions are unobservable, patent data provide the most accurate indication of innovation-related decisions. There is a time lag between these decisions and the patent applications; for example, the legal department needs time to submit the documents to the patent office. Recent accounting and finance research on the relation between information asymmetry and innovation often uses three-year-ahead patent data to account for the delay between the investment in innovation and its realization as a patent application (He and Tian, 2013; Kaplan, 2008).[20] Therefore, I measure current innovation decisions with patent data at time *t+3*.

Disclosure Quality

I measure financial disclosure quality as the principal component of earnings quality (unsigned discretionary accruals) and 10-K readability (the Fog Index and the length of the 10-K).

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[19] Patent data became available only recently. Earlier studies on innovation used R&D expense. In addition to the weakness discussed above, it is important to note that the R&D expense is the input to the innovation process, and thus, it offers no guarantee that innovation will materialize. In addition, firms may either not report their R&D expenses or they may engage in classification shifting so that R&D expenditure may not accurately convey the amount spent to produce innovation in the current period (McVay 2006; Xu and Yan 2013; Koh and Reeb 2015). Finally, R&D expenditure is a “sticky cost” that does not afford much flexibility (Hall and Lerner 2010). According to Kerr and Nanda (2015), “Firms therefore tend to smooth R&D spending over time to avoid having to lay off their research scientists and knowledge workers, leading R&D spending at the firm level to behave as if it has high adjustment costs (e.g., Hall, Griliches, and Hausman 1986)” (448).

[20] This differs from other strands of literature, which test one-year-ahead patent data, probably because management may affect innovation at any stage of the innovative process, whether through the investment decisions or through changing the firm’s strategic priorities and culture (e.g., Galasso and Simcoe 2011).

Unsigned discretionary accruals are the absolute value of the difference between the totals of actual and estimated accruals (determined by the cross-sectional Jones [1991] model, as modified in McNichols [2002]).

Regression Models

Test of Hypothesis 1: The Relation between Disclosure Quality and Innovation

To test my first hypothesis, I regress innovation on disclosure quality and control variables that are common in the literature (e.g., He and Tian 2013).

$$\begin{aligned} Innovation_t = {} & \boldsymbol{\alpha_1 DQ_t} + \gamma_1 LnAssets_t + \gamma_2 RDAssets_t + \gamma_3 NoRDexp_t \\ & + \gamma_4 LnFirmAge_t + \gamma_5 ROA_t + \gamma_6 Leverage_t + \gamma_7 PPEAssets_t \\ & + \gamma_8 CapexAssets_t + \gamma_9 MtoB_t + \gamma_{10} LnAnalysts_t + \gamma_{11} Instit\ Owners_t \\ & + \epsilon_t. \end{aligned} \tag{1}$$

Innovation at year t is the natural logarithm of one plus the measure of innovation (number of patent citations at year *t+3*), so defined, due to the right-skewed distribution of the patent citations (He and Tian 2013). *DQ* is the principal component of earnings quality and 10-K readability. As explained above, the null hypothesis is that α_1, the coefficient for *DQ*, is not different from zero.

LnAssets is the natural logarithm of one plus the firm's total assets. I expect the coefficient to be positive because larger firms have the resources to invest more in innovation and the resources to apply for patents. *RDAssets* is R&D expenditure as a percentage of total assets. The coefficient is expected to be positive because research and development is the input to the innovation process. A higher expenditure should yield more innovation. *NoRDexp* is an indicator variable that equals one if the observation had no R&D expense reported in Compustat (Koh and Reeb 2015). Profitability, *ROA*, enables firms to engage in innovative projects. Similarly, innovation should be positively correlated with growth opportunities, so I expect the coefficient on *MtoB* (market-to-book ratio) to be positive. *LnFirmAge*, the age of the firm, is expected to have a negative relation with innovation because older firms are more likely to be in the mature stage of the life cycle, and thus, they are less likely to be investing cash flows in long-term projects. The coefficient may be positive because mature firms survive through innovation. *PPEAssets* is net PP&E scaled by total assets, and *CapexAssets* is capital expenditures scaled by total assets. These variables control for whether the firm has the facilities for research and continued investment in the equipment and resources required for patentable innovation. Financial risk (*Leverage*) limits a firm's ability to finance innovation, so I expect the coefficient to be negative. *LnAnalysts* and *Instit Owners* are natural logarithms of one plus the number of analysts following the firm and the percentage of institutional ownership, respectively. Prior research has established that they have an impact on firm-level innovation (Aghion et al. 2013; He and Tian 2013).[21] Lastly, controls include firm and year fixed effects to account for differences across firms, and for possible time-series fluctuations in the ease of filing patent applications and in incentives to file for patents (due to changes in the protection provided to intellectual property). Firm fixed effects also control for industry fixed effects, such as product market competition. Standard errors are clustered at the firm level.

Up until now, I have primarily focused on the effect of disclosure quality on innovation. However, innovation may simultaneously affect disclosure quality. Innovation's uncertain nature and high proprietary costs may decrease disclosure quality (Holmstrom 1989). Innovation's uncertain nature makes it more difficult for managers to provide accurate projections as to the firm's future performance, so that managers' have lower quality information regarding the future,

[21] Aghion et al. (2013) show that dedicated and transient institutional owners have a positive association with corporate innovation. I also expect analysts following to have a positive association with innovation, despite the negative association reported by He and Tian (2013), since He and Tian's (2013) result only holds for firms that have at least one analyst following the firm, assuming that no patenting activities indicate lack of innovation (Clarke et al. 2015; Reeb and Zhao 2017).

which may result in less informative disclosure. Similarly, managers may increase the use of accruals to address the greater volatility and uncertainty of cash flows. Moreover, managers may obfuscate information by decreasing earnings quality to avoid disclosing proprietary information, which may be used by the firm's competitors (Bhattacharya and Ritter 1983). Furthermore, patent complexity could decrease the readability of the 10-K, especially because, quite often, innovation is hard to explain.[1] In contrast, innovation is associated with greater investor demand for information. For example, Palmon and Yezegel (2012) document that analysts' recommendation revisions are more valuable for R&D-intensive firms. In response to the greater demand for information, firms may increase voluntary disclosure. Indeed, firms with more patenting activities issue more management earnings forecasts (Huang et al. 2020). However, financial disclosure quality should not be affected by this demand since it is limited in its ability to inform investors regarding innovation (Hirshleifer et al. 2013).

To address this, I conduct Granger causality tests to determine whether disclosure quality leads innovation or innovation leads disclosure quality. Specifically, I regress innovation and disclosure quality on their lagged values:

$$\begin{aligned} LnCites_{t+3} = {} & \boldsymbol{\alpha_1 DQ_t} + \boldsymbol{\alpha_2 DQ_{t-1}} + \alpha_3 LnCites_t + \alpha_4 LnCites_{t-1} + \alpha_5 LnAssets_t \\ & + \alpha_6 RDAssets_t + \alpha_7 NoRDexp_t + \alpha_8 LnFirmAge_t + \alpha_9 ROA_t \\ & + \alpha_{10} Leverage_t + \alpha_{11} PPEAssets_t + \alpha_{12} CapexAssets_t + \alpha_{13} MtoB_t \\ & + \alpha_{14} LnAnalysts_t + \alpha_{15} Instit\ Owners_t + \epsilon_{Innov}. \end{aligned} \quad (2a)$$

$$\begin{aligned} DQ_{t+1} = {} & \beta_1 DQ_t + \beta_2 DQ_{t-1} + \boldsymbol{\beta_3 LnCites_t} + \boldsymbol{\beta_4 LnCites_{t-1}} + \beta_5 LnAssets_t \\ & + \beta_6 LnFirmAge_t + \beta_7 ROA_t + \beta_8 Sales\ Growth_t + \beta_9 Stock\ Return_t \\ & + \beta_{10} Litigation\ Risk_t + \beta_{11} CF\ Vol_t + \beta_{12} Sales\ Vol_t \\ & + \beta_{13} LnAnalysts_t + \beta_{14} Instit\ Owners_t + \epsilon_{DQ} \end{aligned} \quad (2b)$$

To model disclosure quality, controls are added for securities litigation risk: *Sales Growth*, *Stock Return*, and *Litigation Risk* (Kim and Skinner 2012). *Sales Growth* is the percentage change in sales; *Stock Return* is annual stock return over the fiscal year; *Litigation Risk* is an indicator variable that equals one if the firm belongs to a litigious industry and zero otherwise. The study also controls for cash flow and sales volatilities, *CF Vol* and *Sales Vol* respectively, which are likely to influence firms' disclosure decisions. For example, firms with high volatility are more likely to engage in earnings management to meet investors' preference for smooth earnings (Graham et al. 2005).

If disclosure quality affects innovation, I expect α_1 to be statistically significant. While this test cannot verify the direction of causation, if β_3 and β_4 are statistically insignificant, that lends support to disclosure quality affecting innovation rather than being affected by it.

Rebuilding trust

A natural experiment that indicates that disclosure quality inspires trust is provided by the demise of the audit company Arthur Andersen, which was an international conglomerate with offices all over the US and the world. Even though the audit failure occurred in the Dallas office, which did not follow the instructions of the main office, being audited by this firm thereafter carried the stain of untrustworthiness. Partners of Arthur Andersen relocated with their clients to other audit firms. The purpose of the shift was to lend credibility to the financial report and to enable firms to restore the trust of investors (Chakravarthy et al. 2014). To maintain trust, firms now were under pressure to increase disclosure quality. Therefore, the change in auditor was an external and unexpected shock to firms previously audited by Arthur Andersen. Since some firms already had high disclosure quality, I focus on the firms whose disclosure quality improved following the shock and use the firms that did not change auditors as a control group to conduct a difference-in-differences test.

Similarly, trust would deteriorate after a restatement due to material weakness or fraud. Therefore, I use restatement data from Audit Analytics to test whether the relation between disclosure quality and innovation is stronger following a trust-deteriorating restatement. My sample includes both firms that had such a restatement and a matched sample of firms that had no restatement in the three years before (pre-period) and after (post-period) the treatment group's restatement. The deterioration in trust may have a spillover effect, so that in the post-period, firms that did not have a misstatement would have a stronger relation between disclosure quality and innovation. Therefore, my variable of interest is the interaction term of the post-period with financial disclosure quality.

I also test whether the coefficients are significant for pseudo-shock dates. That is, I rerun the tests but with shifted pre- and post- periods. Insignificant coefficients for these pseudo shocks lends support to the shocks having an effect rather than capturing a time trend.

Test of Hypothesis 2: Cross-Sectional Tests

To test the conditions under which the relation between disclosure quality and innovation is stronger, I add interaction terms with disclosure quality to the regression of innovation on disclosure quality. Specifically, I add interaction terms with Reg FD, stock price illiquidity (measured by bid-ask spreads), firm size, and the indicator variable for missing R&D expenditures. The controls are the same as above.

As explained in the hypotheses development above, I expect the relation between disclosure quality and innovation to be stronger following the passage of Reg FD, which increased the importance of disclosure quality due to its limitations on private communications.

Furthermore, I expect the relation to be stronger when stock is illiquid and firms are more vulnerable to investors' trust. Therefore, I expect the coefficients for the interaction terms with an indicator variable for Post-Reg FD with illiquidity to be positive.

Similarly, I expect disclosure quality's respective interactions with size and R&D expenditure reporting to have positive coefficients, as firms with higher visibility and firms with lower proprietary costs would lose trust if their disclosure quality was not high. Furthermore, monitoring is higher in these situations, so disclosure quality may play a more important role in building the trust to innovate.

For the most part, these situations are expected to influence disclosure quality more than innovation directly, thereby giving some indication as to the direction of causation.

The mechanism: access to financing

Investors' trust may influence innovation in the following ways. It may manifest in investors' willingness to provide financing for the firm, to continue holding the firm's shares in times of temporary setbacks, to give managers the benefit of the doubt, and to intervene less in managers' decisions. I focus on the most significant and visible mechanism, which is the access to financing. Since the access to financing includes both equity and debt financing, this mechanism encompasses both investors' and debtors' trust.

A path analysis is used to determine whether disclosure quality affects innovation economically, through access to financing. The path analysis uses a simultaneous equations model to model innovation as a function of access to financing, disclosure quality, and controls, and to model access to financing as a function of disclosure quality. The advantage of the structural equation model is its flexibility in modeling complex simultaneous relations among variables, enabling the examination of the direct and indirect effects, while taking into account measurement errors in both dependent and independent variables.[22] This structural equation model makes it possible to conduct a path analysis to test the following simultaneously: (1) the direct effect of disclosure quality and access to financing on innovation, and (2) the indirect effect of disclosure

[22] In general, an additional advantage of the structural equation model is the inclusion of latent constructs. However, the principal component of disclosure quality is calculated separately rather than including it as a latent variable.

quality on innovation through its influence on access to financing. Formally, I estimate the following simultaneous equations:

$$Innovation_t = \boldsymbol{\alpha_1 DQ_t} + \boldsymbol{\alpha_2 Access\ to\ Fin_t} + \alpha_3 LnAssets_t + \alpha_4 RDAssets_t + \alpha_5 NoRDexp_t + \alpha_6 LnFirmAge_t + \alpha_7 ROA_t + \alpha_8 Leverage_t + \alpha_9 PPEAssets_t + \alpha_{10} CapexAssets_t + \alpha_{11} MtoB_t + \alpha_{12} LnAnalysts_t + \alpha_{13} Instit\ Owners_t + \epsilon_{Innov}. \quad (3a)$$

$$Access\ to\ fin_t = \boldsymbol{\varphi_1 DQ_t} + \varphi_2 Access\ to\ Fin_{t-1} + \varphi_3 LnAssets_t + \varphi_4 LnFirmAge_t + \varphi_5 ROA_t + \varphi_6 Leverage_t + \varphi_7 LnAnalysts_t + \varphi_8 Instit\ Owners_t + \epsilon_{Access\ to\ fin}. \quad (3b)$$

$$DQ_t = \beta_1 Access\ to\ Fin_t + \beta_2 LnAssets_t + \beta_3 LnFirmAge_t + \beta_4 ROA_t + \beta_5 Sales\ Growth_t + \beta_6 Stock\ Return_t + \beta_7 Litigation\ Risk_t + \beta_8 CF\ Vol_t + \beta_9 Sales\ Vol_t + \beta_{10} LnAnalysts_t + \beta_{11} Instit\ Owners_t + \epsilon_{DQ} \quad (3c)$$

Access to Fin is measured as an indicator variable that equals one if the annual change in the percentage of outstanding shares, long-term debt, or short-term debt are greater than 25 percent, and it equals zero if they are less than 1 percent.

The controls in Eqs. (3a) and (3c) are the same as in Eq. (1) and (2b), respectively. The direct effect of the access to financing on innovation is captured by the coefficient α_2 in Eq. (3a), and the effect of disclosure quality on the access to financing is captured by the coefficient φ_1 in Eq. (3b). The direct effect of disclosure quality on innovation is captured by the coefficient α_1 in Eq. (3a). The indirect effect is $\varphi_1 \cdot \alpha_2$ (i.e., the effect of disclosure quality on the access to financing multiplied by the effect of access to financing on innovation). The total effect is the sum of the direct and indirect effects.

Sample

The sample includes firm-year observations between 1996 and 2010. The patent data is retrieved from the database on the website of the United States Patent and Trademark Office (USPTO). Disclosure quality includes unsigned discretionary accruals and the Fog Index and length of the 10-K filing. Firm-level control variables are obtained from Compustat, I/B/E/S, and the Thomson

Reuters Institutional (13F) Holdings Database. Patent data restricts the sample to ending in 2010 (to account for the time lag between applications and grant dates).

In accordance with the previous literature, this study uses only applications for utility patents, which constitute over 90 percent of the patents granted every year. Patents are matched to firm identifiers based on the NBER patent data project, which matches patent number to Compustat *gvkey* until 2006. I also use the data from Kogan et al. (2017), obtained from Noah Stoffman's website, in order to match the firm names to unique identifiers for firm names that did not appear before 2006. The identification assigns subsidiaries' patents to parent companies, so that firms that acquire continuously innovative firms, are also considered innovative. Similar to Aghion et al. (2013), I obtain patent grants through 2013 and trace patent applications up until 2010. The three-year gap reflects the reality that there is an average three-year lag between application and grant. It also addresses a potential truncation issue in future citations.

Table 1 describes the sample selection. The initial sample comprises 30,859 firm-year observations, for 4,872 firms, between the years 1996 and 2010 with non-missing variables. The time period is chosen based on data availability. Following Koh and Reeb (2015), missing R&D expenditure item is assumed to total zero and an indicator variable is added to the regressions to identify the observations for which this assumption was applied. Table 1 shows that 91 observations in the financial and utilities industries (SIC between 6000 and 6999 and between 4900 and 4999) are excluded because their reporting regulation is different, and financial reporting for the disclosure quality construct is required. Finally, I delete 14,428 observations for firms that did not apply for any patent during the entire sample period. The final sample comprises 16,340 firm-year observations (2,351 firms).

Table 2, Panel A, presents the descriptive statistics for the variables. A description of the variables is detailed in Appendix A. All continuous control variables are winsorized at the top and bottom 1 percent. The average three-year-ahead number of citations ($Cites_{t+3}$) is 120.50. However, the distribution of the patent data is highly skewed, with a median of one patent citation. While the skewedness of the sample is similar to other papers that utilize patent data, the firms in my sample have on average a larger number of citations than papers like He and Tian (2013) and Zhong (2018), since this study focuses on firms that utilize patent protection. The sample in this study is comparable to the one used by Biddle et al. (2009) to test the effect of financial disclosure quality on its investment decisions. They examine investment efficiency, while I document the relation with innovation. They report a sample with a mean (median) Fog Index of 19.46 (19.15), which is similar to this sample's mean (median) of 19.46 (19.33). The firms in the current study's sample are slightly larger, with a mean (median) of the natural logarithm of total assets of 5.85 (5.67), and have more analysts following the firm, with a mean (median) of 12.31 (5).

Panel B presents the Pearson's correlations among the main variables. There are no large correlations among the independent variables, which alleviates concerns about multicollinearity.

Panel C details the industry distribution of the patent data. As expected, most of the observations are in business services (2,193 observations), electronic equipment (1,946 observations), pharmaceutical products (1,763 observations), and medical equipment (1,119 observations). However, there are also observations in almost all of the other industries, including industries which rely less on innovation, such as textiles (94 observations), candy and soda (35 observations), and precious metals (20 observations). Interestingly, the industry with the highest average of annual patent citations is the entertainment industry (average of 276.53 annual patent citations), followed by agriculture (average of 266.13 annual patent citations) and aircraft (average of 257.37 annual patent citations).

IV. RESULTS

Test of Hypothesis 1: Disclosure Quality and Innovation

Table 3 presents the regression results for the association between innovation and financial disclosure quality. Column 1 presents the main results, which indicate that disclosure quality has a positive association with innovation. The coefficient on *DQ* is 0.026 (*t*-statistic 2.185). This relation is confirmed in columns 2 and 3, in which innovation is measured with the number of patent applications and with patent data in year *t+1*, respectively. In column 2, the coefficient on *DQ* is 0.019 (*t*-statistic 3.035) and in column 3 the coefficient is 0.023 (*t*-statistic 1.963). Untabulated analysis shows that the results continue to hold with a binary variable for high innovation as measured by the top industry-year trecile of $LnCites_{t+3}$. Overall, the results presented in Table 3 Panel A support the first hypothesis that higher disclosure quality is associated with more innovation. From an economic perspective, a one standard deviation increase in *DQ* is associated with a 3 percent increase in the number of citations.[23]

The difference between column 1 and 3 stems from the possibility that disclosure quality may affect innovation either at the initial stage of the innovative process (upon choosing a project) or during the process (via continued funding for an existing project). The positive association of disclosure quality with innovation being stronger for *t+3* than for *t+1*, suggests that high disclosure quality enables firms to raise capital necessary to take on new innovative projects, which require a bit more time to translate into patent applications.

[23] *DQ* has a standard deviation of 1.04. When it is multiplied by *DQ*'s coefficient of 0.026, then the natural logarithm of one plus the number of patent citations is 0.027, which translates to a 3% increase in patent citations.

With regard to the controls, the signs of the coefficients are in the expected direction. Firm size is positively associated with innovation, as larger firms have more resources to invest in innovation. Similarly, *RDAssets* has a positive coefficient, as it indicates that firms invest in the R&D necessary for innovation. However, although it has a positive association with innovation measures based on patent applications in year *t+1*, the association is statistically insignificant based on year *t+3*. This pattern is consistent with the immediate expensing of R&D spending, so it is associated with ongoing financing rather than with project initiation. Market-to-book ratio, *MtoB*, is also positively associated with innovation, indicating that firms with growth opportunities innovate. In contrast, financially constrained firms usually have less leeway to innovate, consistent with a negative association between leverage and innovation.

Granger causality tests

In Table 4, I present the results for the Granger causality tests. Columns 1 through 3 show that the coefficient for disclosure quality is statistically significant in the innovation regressions. In column 1, the dependent variable is $LnCites_{t+3}$, and the coefficient for DQ_t is 0.031 (*t*-statistic 2.479). Columns 4 and 5 show that the coefficients for the lagged innovation are statistically insignificant in the disclosure quality regressions. In column 4, the coefficient for $LnCites_t$ has a t-statistic of 0.122, and in column 5, the coefficient for $LnCounts_t$ has a t-statistic of -0.505. While these regression do not prove causation, they do imply that disclosure quality is prior to innovation, which is consistent with disclosure quality affecting innovation.

Self-Selection

In Appendix B, I present the results of a two-stage Heckman analysis to address potential self-selection concerns that arise from the fact that not all innovation is captured by patents, as some firms utilize trade secrets for intellectual property protection instead. My results still hold.

Rebuilding Trust following the Enron Scandal

To provide support for the effect of disclosure quality on innovation, an exogenous shock is used to determine disclosure quality, which is unlikely to affect innovation: Arthur Andersen's closure in 2002 following the Enron scandal. Specifically, I examine firms whose disclosure quality improved when they moved to a new auditor because of Arthur Andersen's demise. The change in innovation in 2003 is compared to 2001. The regression analysis includes firms that did not change auditors as a control group. The results are presented in Table 5. *post_scandal* is an indicator variable that equals one for fiscal year 2003 and zero for fiscal year 2001. *DQimprove* is an indicator variable that equals one for firms whose disclosure quality improved when they switched auditors following Arthur Andersen's closure, and zero for firms that did not change auditors. This variable is subsumed in the firm fixed effects. For the sake of brevity, I present only the coefficient for the interaction term of *post_scandal* and *DQimprove*. The regressions include the controls used throughout the paper. Column 1 shows that disclosure quality did change for the treatment group following the move to a new auditor: the coefficient for *post_scandal*×*DQimprove* is 0.864 (*t*-statistic 6.778). The coefficient for *post_scandal* is not statistically different from zero (*t*-statistic -1.264), which implies that there was no overall change in disclosure quality. Column 2 shows that innovation increased for the treatment group following the move to a new auditor. The coefficient for the interaction term is 0.376 (*t*-statistic 2.695), and the coefficient for *post_scandal* is -0.483 (*t*-statistic -6.697). Following the scandal, there is a decrease in innovation, which is consistent with the notion that scandal deteriorates trust, and thereby reduces a firm's ability to innovate. The positive coefficient on the interaction term implies that the firms that improved their disclosure quality may have restored some of that trust, and were therefore able to innovate more than the firms in the control group.

In columns 3-6, I rerun the regressions for pseudo shock dates by using alternative definitions of *post_scandal*. *post_scandal* is shifted back by two years and one year in columns 3 and 4 respectively. *post_scandal* is shifted forward by two and three years in columns 5 and 6 respectively. In all these columns the interaction term *post_scandal*×*DQimprove* is not statistically significant, which confirms that it is the 2002 Enron scandal that drives the results in column 2.

Rebuilding Trust following Restatement

To provide support for the argument that trust explains the effect of disclosure quality on innovation, I focus on restatements that are posited as deteriorating trust. I expect and find that the positive relation between disclosure quality and innovation is stronger in the three years following a trust-deteriorating restatement. The results are presented in Table 6. *post_Res* is an indicator variable that equals one for the three years following a restatement due to material weakness or fraud, and is zero for the three years before the restatement. *post_Res*×*DQ* is its interaction term with financial disclosure quality. For the sake of brevity, I present only the coefficients for the variables of interest. The regressions include the controls used throughout the paper. The firms that did not restate are matched based on fiscal year and firm size (total assets in the year prior to the restatement) in columns 1 and 3-6, and also on disclosure quality in the year before the restatement in column 2. Both columns 1 and 2 show that the positive relation between innovation and disclosure quality is stronger following the restatement. The coefficient for *post_Res*×*DQ* is 0.199 (*t*-statistic 2.034) in column 1 and 0.152 (*t*-statistic 1.975) in column 2. Columns 3-6 confirm that the results are driven by the restatements and do not hold for pseudo shocks in the years around the restatements. The positive coefficient on the interaction term implies that high disclosure quality enables innovation by restoring trust.

Test of Hypothesis 2: Cross-Sectional Tests

Changes in monitoring and proprietary costs are expected to influence disclosure quality's effect on innovation, but not innovation's effect on disclosure quality. Table 7 shows that the association between disclosure quality and innovation is stronger post Reg FD, weaker with high liquidity, stronger for big firms, and weaker for firms that do not report R&D expenses.

In column 1, the coefficient for the interaction term *DQ×RegFD* is 0.079 (*t*-statistic 2.655). This positive coefficient confirms that when private communication was restricted, financial disclosure quality plays a bigger role in enabling firms to innovate. The passage of Reg FD directly affected firms' disclosure decisions. The effect of Reg FD contradicts the explanation that disclosure quality increases innovation by reducing internal adverse selection frictions (Park 2018). If the effect of financial reporting quality was via its association with better internal reporting, the relation between disclosure quality and innovation would hold also prior to Reg FD. Since the relation holds only post-Reg FD, the results are consistent with disclosure quality's importance for external, rather than internal, communication.

Furthermore, when firms are more vulnerable to investors' trust, as indicated by illiquidity, disclosure quality has a stronger association with innovation. In column 2, the coefficient for the interaction term *DQ×illiquidity* is 1.426 (*t*-statistic 3.079).

As expected, disclosure quality's interaction with size has a positive coefficient and the interaction with R&D expenses reporting has a negative coefficient. The coefficient for the interaction term *DQ×LnAssets* is 0.027 (*t*-statistic 3.890). Last, in column 4, the coefficient for the interaction term *DQ×NoRDexp* is -0.102 (*t*-statistic -3.494). This negative coefficient is consistent with non-disclosure of R&D expenses, indicating that proprietary costs are high enough that firms may decrease disclosure quality without eroding investors' trust. These coefficients are consistent with the notion that firms need to maintain the expected high disclosure quality in order to sustain the trust necessary for innovation.

Next, I test the effect of the importance of individualized trust. Individualized trust is the trust towards the specific firm, as opposed to generalized trust, described earlier. When firms report a loss, trust is more important to maintain investor's support that enables firms to innovate. The distribution of state-level generalized trust is described in Appendix D. In column 5, of Table 7, the sample is restricted to observations with negative net income. The coefficient for disclosure quality is 0.051 (*t*-statistic 2.298). This supports my hypothesis that trust is instrumental in firms' ability to innovation, not only because this is a setting that requires trust, but also because this refutes a claim that firms that have "good news" are able both to report higher quality earnings and to invest more in innovation.

Furthermore, investors may pay attention to disclosure quality only if generalized trust is sufficient for them to do so. Table 8 shows that the association between disclosure quality and innovation holds for firms with headquarters in states with high generalized trust, but not in states with low generalized trust.[24] In column 1, where the analysis is conducted for firms with generalized trust above the national median, the coefficient for *DQ* is 0.038 (*t*-statistic 2.111). However, in column 2, where the analysis is conducted for firms with generalized trust below the national median, the coefficient for *DQ* is not statistically significant (*t*-statistic 0.834). Columns 3 and 4 show that the results continue to hold when the measure of innovation is replaced with patent count. These results imply that in order for financial disclosure quality to build trust,

[24] I am assuming that investors have a home bias, so that the location of the firm's headquarters is associated with the location of its influential investors.

investors need to have a high enough level of generalized trust to give the financial statements due consideration and distinguish among firms' trustworthiness by their disclosure quality.

The Mechanism through Which Disclosure Quality Affects Innovation

I next investigate whether disclosure quality affects innovation through its influence on the access to financing. The results of the path analysis are presented in Figure 1. Consistent with disclosure quality's role in fostering trust, it has a positive association with the access to financing (coefficient 0.294, *Z*-statistic 2.22). Furthermore, as expected, access to financing increases innovation (coefficient 0.027, *Z*-statistic 3.45). This result is consistent with the notion that access to financing provides capital for innovation. Most importantly, this analysis demonstrates that high disclosure quality increases innovation beyond the effect of the access to financing. While the total effect is 0.055 (*Z*-statistic 7.22), the indirect effect is statistically insignificant (*Z*-statistic 1.35).[25] These results suggest that higher disclosure quality increases innovation only partly through its effect on access to financing, and is consistent with high disclosure quality inspiring the trust needed for firms to have the autonomy to innovate.

V. SUMMARY AND CONCLUSION

This paper furthers the understanding of the real effects of disclosure quality and explains that high quality financial disclosure may foster investors' trust. This trust explains the positive association between financial disclosure and innovation, which is a setting in which financial disclosure can do little to reduce the information asymmetry between managers and investors.

I find a positive association between disclosure quality and innovation. Granger causality test implies that disclosure quality leads innovation. Cross-sectional tests show that the positive

[25] The indirect effect is insignificant due to the result that access to financing reduces disclosure quality. The intuition is that when a firm raised capital (debt or equity) it has less incentive to bear the cost of high quality disclosure.

relation between disclosure quality and innovation is stronger after Regulation Fair Disclosure for firms with high monitoring and those with high visibility, but weaker for firms with high proprietary costs. This positive relation holds only when generalized trust is high, which implies that only then are investors willing to be trusting when firms are more trust-worthy per their level of disclosure quality. Furthermore, a difference-in-differences test around Arthur Andersen's demise shows that firms with improved disclosure quality due to an involuntary change in auditors demonstrate higher levels of innovation than firms that did not switch auditors. Similarly, the positive association between innovation and disclosure quality is higher following truth-deteriorating restatements. In these circumstances, disclosure quality plays a more important role in building the trust necessary for the creative process on which innovation is based.

A path analysis indicates that disclosure quality affects innovation in part through its effect on the access to financing, but its influence extends beyond it. The results of the path analysis imply that the trust that disclosure quality fosters both facilities firms' access to financing and supports innovation beyond firms' ability to raise capital by providing managers with the autonomy to innovate (such as the reduction of career concerns mentioned in Zhong 2018).

Thus, this paper provides evidence consistent with the notion that higher disclosure quality increases corporate innovation. Since innovation requires a certain degree of autonomy, which is only possible in the presence of trust, the results suggest that financial disclosure quality not only plays stewardship and contracting roles, but also builds trust.

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Appendix A
Variable definitions

Variable Name	**Description** (definitions of Compustat variables are shown in italics)
Innovation	
$Cites_t$	Patent quality in year *t*, as measured by the number of future citations for the patents, for which the firm applied during a year that were eventually granted. A prefix *Ln* indicates that the variable is the natural logarithm of the number of citations plus one.
$Counts_t$	Patent quantity in year *t*, as measured by the number of utility patents, for which the firm applied during a year that were eventually granted. A prefix *Ln* indicates that the variable is the natural logarithm of the patent count plus one.

Variable Name	**Description** (definitions of Compustat variables are shown in italics)
Disclosure Quality	
DQ_t	Financial disclosure quality measured by the principal component of 10-K readability and accruals earnings quality in year *t.* Readability is measured with the Fog Index and the number of words in the 10-K. Unsigned discretionary accruals in year *t*, as estimated by the model in Jones (1991) and modified in McNichols (2002): $\frac{TA_t}{Assets_{t-1}} = \beta_1 \frac{1}{Assets_{t-1}} + \beta_2 \frac{\Delta Sales_t}{Assets_{t-1}} + \beta_3 \frac{PPE_t}{Assets_{t-1}} + \beta_4 CFO_{t-1} + \beta_5 CFO_t + \beta_6 CFO_{t+1} + \epsilon_t.$ where *TA* are changes in non-cash working capital, measured as the net income before extraordinary items (Compustat item *ibc*) minus the cash flow from operations (Compustat item *oancf*); Δ*Sales* is the annual change in sales, measured as the change in Compustat item *sale*; *PPE* is year-end property, plant, and equipment (Compustat item *ppegt*); *Assets* are the total assets (Compustat item *at*); CFO is operating cash flows (Compustat item *oancf*). Discretionary accruals are total accruals minus the predicted accruals from industry-year regressions. (Each industry-year has at least 15 observations.) Unsigned discretionary accruals are the absolute value of the discretionary accruals.
Firm level controls	
$LnAssets_t$	Natural logarithm of total assets in year *t* (*at*) plus one.
$RDAssets_t$	Investment in intangible assets—research and development expenditure in year *t* deflated by total assets (*xrd/at*).

Variable Name	**Description** (definitions of Compustat variables are shown in italics)
$NoRDexp_t$	Indicator variable that equals 1 if R&D expenditure is not reported in year *t* and 0 otherwise.
$LnFirmAge_t$	Natural log of one plus the firm age in year *t*, where the age is based on the number of years the firm has existed in CRSP monthly stock return files.
ROA_t	Profitability—return on assets in year *t*, defined as operating income before depreciation divided by total assets (*oibdp/at*).
$PPEAssets_t$	Asset tangibility—property, plant, and equipment in year *t* deflated by total assets (*ppent*/*at*).
$Leverage_t$	Book value of debt in year *t* deflated by total assets ((*dltt* + *dlc*) / *at*).
$CapexAssets_t$	Capital expenditure in year *t* deflated by total assets (*capx / at*).
$MtoB_t$	Market-to-book ratio in year *t* (*mkvalt / bkvlps*).
$Analysts_t$	Natural logarithm of one plus the number of analysts following the firm in year *t*. The number of analysts is the variable *analysts* in I/B/E/S. If firm *i* is not in I/B/E/S, the number of analysts is assumed to be zero.
$Instit\ Owners_t$	The percentage of shares owned by institutional investors in year *t*, calculated from the Thomson Reuters Institutional (13f) Holdings.
$RegFD_t$	Indicator variable that equals 1 post-Regulation Fair Disclosure (i.e., if year *t* is after 2000) and equals 0 if year *t* is before 2000.
$illiquidity_t$	Stock price illiquidity measured as -1 multiplied by the difference between the bid and ask price divided by the average of the two.
$CF\ Vol_t$	Volatility of cash flows in year *t*, measured as the volatility of operating cash flows (*oancf*) over the previous five years, scaled by the average of total assets over those same five years.

Variable Name	**Description** (definitions of Compustat variables are shown in italics)
Sales Vol$_t$	Volatility of sales in year *t*, measured as the volatility of sales (*sale*) over the previous five years, scaled by the average of total assets over those same five years.
Litigation Risk$_t$	Indicator variable that equals 1 if the firm belongs to a litigious industry in year *t* (SICs 2833–2836, 3570–3577, 3600–3674, 7370–7374, 5200–5961, 8731–8734) and 0 otherwise.
Sales Growth$_t$	Percentage change in sales in year *t* (*sale*) as compared to the previous year.
Stock Return$_t$	Annual stock price return calculated at the end of fiscal year *t* based on Compustat variable *prcc_f*.
Access to Fin$_t$	Indicator variable that equals 1 if the annual change in the percentage of outstanding shares (*csho*), long-term debt (*dltt*), or short-term debt (*dlc*) are greater than 25 percent, and it equals 0 if they are less than 1 percent.
UsesPatents$_t$	Indicator variable that equals 1 if the firm was included in the main analysis because it is identified as a firm that utilized patent protection and 0 otherwise.
TradeSecretProt$_t$	Measure of state-level trade secret protection from Png (2015).
OS Prospector$_t$	Indicator variable that equals 1 if the firm's organizational structure is identified as a Prospector according to the Miles and Snow (1978) classification and 0 otherwise.
OS Defender$_t$	Indicator variable that equals 1 if the firm's organizational structure is identified as a Defender according to the Miles and Snow (1978) classification and 0 otherwise.

Appendix B
Patent-Users Sample Selection

To address self-selection concerns, I employ the two-stage Heckman procedure. In the first stage, the decision to utilize patent protection is modeled by including indicator variables for state-level trade secret protection (Png 2015, 2017) and the firm's organizational strategy (Miles and Snow 1978). The Inverse Mills Ratio (IMR) is calculated in the first stage of the model and then included in the main regressions.

$$\begin{aligned} UsesPatents_t = {} & \boldsymbol{\alpha_1 TradeSecretProt_t} + \boldsymbol{\alpha_2 OS\ Prospector_t} \\ & + \boldsymbol{\alpha_3 OS\ Defender_t} + \alpha_4 LnAssets_t + \alpha_5 RDAssets_t \\ & + \alpha_6 NoRDexp_t + \alpha_7 LnFirmAge_t + \alpha_8 ROA_t + \alpha_9 Leverage_t \\ & + \alpha_{10} PPEAssets_t + \alpha_{11} CapexAssets_t + \alpha_{12} MtoB_t + \alpha_{13} LnAnalysts_t \\ & + \alpha_{14} Instit\ Owners_t + \epsilon_{Innov}. \end{aligned} \tag{A1}$$

UsesPatents is an indicator variable that equals one if the firm was included in the main analysis, as it is identified as a firm that utilized patent protection, and zero otherwise. *TradeSecretProt* is a measure of state-level trade secret protection from Png (2015). I expect firms in states with more trade secret protection use less patent protection, as there is less risk with keeping their innovation secret. Alternatively, firms often utilize both trade secrets and patent protections when they innovate, so high trade secret protection may encourage innovation, which would also increase the use of patent protection. *OS Prospector* is an indicator variable that equals one if the firm's organizational structure is identified as a Prospector according to the Miles and Snow (1978) classification, and *OS Defender* is an indicator variable that equals one if the firm's organizational structure is identified as a Defender according to the Miles and Snow (1978) classification. Firms identified as Prospectors are expected to be more innovative, and therefore, more likely to employ patent protection, while Defenders are expected to focus on cost cutting and therefore, be less likely to utilize patent protection.[26]

The results of the two-stage Heckman analysis are presented in Table A1. Column 1 shows the results of the first-stage Probit regression, used to calculate the Inverse Mills Ratio. As

[26] Bentley, Omer, and Sharp (2013) document an association between organizational structure and financial misreporting. However, while this paper focuses on corporate transparency, Bentley et al. (2013) look at extreme cases of misreporting: AAERs, lawsuits due to accounting improprieties, and accounting restatements.

expected, *TradeSecretProt* has a negative coefficient (-0.124, *t*-statistic -0.533), although it is not statistically significant; *OS Prospector* has a positive coefficient (0.215, *t*-statistic 2.787); and *OS Defender* has a negative coefficient (-0.036, *t*-statistic -0.595). The Inverse Mills Ratio from the first stage is included in the second stage regressions presented in columns 2 and 3, as *IMR*. The coefficient for *IMR* is not statistically significant: the *t*-statistic is 0.500 in column 2 for patent quantity and -0.171 in column 3 for patent quality. In both regressions, the coefficient for disclosure quality continues to be positive and significant: 0.018 (*t*-statistic 2.436) for patent quantity in column 2 and 0.106 (*t*-statistic 6.734) for patent quality in column 3. There are fewer observations in the second stage of the Heckman model than in the main analysis because the *TradeSecretProt* variable is limited to the states identified by Png (2015). The results do not change if this variable is excluded from the first stage reported in column 1. Overall, the two-stage Heckman analysis confirms that the results are not driven by firms self-selecting to utilize patent protection.

Appendix C

Endogenous Relation Between Disclosure Quality and Innovation: 2SLS

Given the endogenous relation between disclosure quality and innovation, the 2SLS estimation can provide further support for disclosure quality's effect on innovation. In the first stage, Eq. (2a) and (2b) (excluding *Innovation*) are combined to predict *DQ*. As explained in the research design section above, *Sales Vol* is the instrumental variable in Eq. (2b), and therefore, it is excluded from the second stage of the 2SLS. The predicted *DQ* replaces the observed *DQ* in the second stage of the 2SLS.

The results of the 2SLS model are presented in Table A2. Columns 1 and 4 show the results for the first stage of the 2SLS and confirm that the sales volatility is indeed correlated with disclosure quality. Column 1 is for the sample used for innovation based on patent applications in year *t+1*, and column 4 is for the sample used for innovation based on patent applications in year *t+3*. Since only one variable is used as an instrument, there is no issue with an over-identifying restriction. To test that the instrumental variables are sufficiently correlated with *DQ*, I compare the explanatory power of the first-stage regression with what it would have been without the instrumental variable. For column 1, the adjusted R^2 for the first stage is 0.175 and the partial R^2 is 0.001, which is a significant difference at the 1% level (robust F-test 22.89); for column 4, the adjusted R^2 for the first stage is 0.162 and the partial R^2 is 0.001, which is a significant difference at the 1% level (robust F-test 18.60). These significant differences confirm that the instrumental variable is sufficiently correlated with the endogenous variable. Furthermore, weak identification is rejected by the Cragg-Donald Wald F statistic 20.385 (16.829) and the Kleibergen-Paap Wald rk F statistic 22.889 (18.605) for the sample with innovation in year *t+1* (*t+3*).

The second stage of the 2SLS confirms the results in Table 3. Columns 2, 3, 5, and 6 present the results for the second-stage analysis. Columns 2 and 3 contain results with innovation based on patent applications in year *t+1*. The coefficients for predicted *DQ* are 2.248 (*t*-statistic 4.303) and 2.480 (*t*-statistic 3.767) for patent quantity and patent quality, respectively. Columns 5 and 6 describe results with innovation based on patent applications in year *t+3*. The coefficients for predicted *DQ* are 2.045 (*t*-statistic 3.777) for patent quantity and 2.197 (*t*-statistic 3.318) for patent quality.

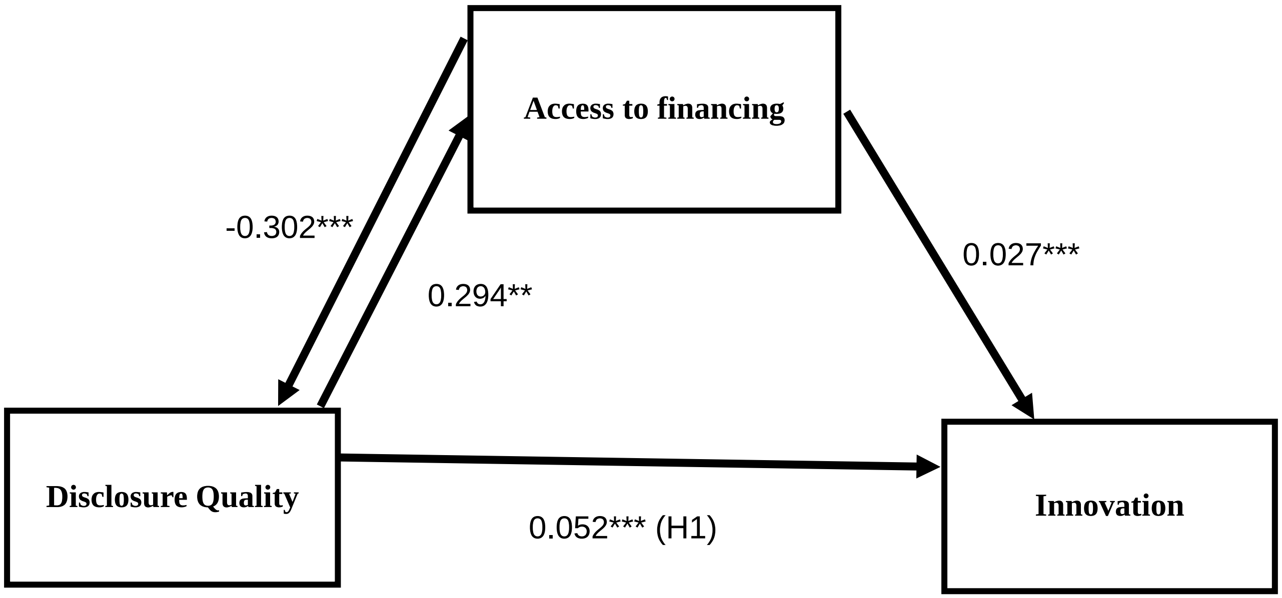
Appendix D
State-Level Generalized Trust

State	Generalized Trust	Number of observations
NH	0.66	157
SD	0.63	36
MN	0.62	724
IA	0.6	81
ID	0.58	32
UT	0.57	183
WA	0.56	524
ME	0.55	32
OR	0.54	283
MD	0.53	297
CO	0.52	447
DE	0.52	61
MA	0.52	1,580
ON	0.52	21
QC	0.52	11
KS	0.51	49
MT	0.51	14
MI	0.5	558
OH	0.49	878
AZ	0.48	262
NE	0.48	67
WI	0.48	419
CT	0.47	629
IL	0.47	990
NJ	0.47	922
VA	0.47	463
PA	0.46	833
MO	0.45	357
CA	0.44	4,920
NY	0.44	1,553
IN	0.42	313
KY	0.42	85
TN	0.41	213
FL	0.4	487
TX	0.4	1,499
NM	0.39	9
SC	0.39	65
WV	0.39	7
AL	0.38	82
AR	0.38	73

State	Generalized Trust	Number of observations
GA	0.38	575
NC	0.38	354
MS	0.37	13
OK	0.37	87
HI	0.35	13
NV	0.35	132
LA	0.3	53
RI	0.29	97
DC	0.27	28

Figure 1 Path analysis results to include the effect of access to financing

$$\boldsymbol{Access\ to\ Fin_{i,t} = \gamma_1 DisclosureQuality_{i,t} + Controls}$$



$$\boldsymbol{Innovation_{i,t} = \alpha_1 Access\ to\ Fin_{i,t} + \beta_1 DisclosureQuality_{i,t} + Controls}$$

Indirect effect: 0.003
Total effect: 0.055***

TABLE 1
Sample selection

This table reports the selection of the sample used in the main regressions. I start with all the firms for which I have all the necessary variables and exclude firms that are in the financial and utility industries and firms that do not utilize patent protection. A firm is classified as not utilizing patent protection if it does not have even one patent application in the USPTO database till 2013.

	Number of Observations	Number of Firms
Sample from 1996 to 2010 with all variables	30,859	4,872
Excluding:		
Financial and utility industries (SIC between 6000 and 6999 and between 4900 and 4999)	91	10
Firms that do not utilize patent protection	14,428	2,511
Total number of observations	16,340	2,351

TABLE 2
Descriptive statistics

This table reports the summary statistics of the variables included in the main regressions. Panel A presents the descriptive statistics. Panel B describes the Pearson correlations among the main variables. The statistically significant correlations are in bold, and p-values are in parentheses. Panel C details the distribution of the patent data by industry. $Cites_{t+3}$ is the number of citations for patents for which the firm applied during year $t+3$ that were eventually granted. See Appendix A for the full list of variable definitions.

Panel A: Descriptive statistics (N = 16,340)

Variable	mean	Sd	p25	p50	p75
$Cites_{t+3}$	120.50	450.56	0.00	1.00	31.00
DiscAccruals	0.08	0.09	0.02	0.05	0.09
Fog	19.46	1.40	18.52	19.33	20.21
Length (words/100,000)	0.30	0.21	0.17	0.25	0.37
DQ	0.05	1.01	-0.36	0.21	0.68
LnAssets	5.85	1.99	4.33	5.67	7.20
RDAssets	0.08	0.12	0.00	0.04	0.11
NoRDexp	0.19	0.39	0.00	0.00	0.00
FirmAge (years)	18.95	15.30	7.00	13.00	29.00
ROA	0.06	0.21	0.02	0.11	0.17
PPEAssets	0.22	0.17	0.09	0.17	0.30
Leverage	0.18	0.19	0.01	0.14	0.30
CapexAssets	0.05	0.04	0.02	0.04	0.06
MtoB	2.45	2.07	1.24	1.76	2.81
Analysts	12.31	18.65	0.00	5.00	17.00
Instit Owners	0.42	0.31	0.13	0.42	0.68
Instit Owners – DED	0.08	0.13	0.00	0.02	0.10
Instit Owners – TRA	0.13	0.13	0.03	0.10	0.19
Instit Owners – QIX	0.27	0.23	0.07	0.23	0.42

Panel B: Correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	$Cites_{t+3}$	1.00										
(2)	DQ	**-0.03**										
		(0.00)										
(3)	LnAssets	**0.31**	**-0.17**									
		(0.00)	(0.00)									
(4)	RDAssets	0.00	**-0.07**	**-0.40**								
		(-0.99)	(0.00)	(0.00)								
(5)	FirmAge	**0.14**	**-0.02**	**0.52**	**-0.31**							
		(0.00)	(0.01)	(0.00)	(0.00)							
(6)	ROA	**0.11**	**0.09**	**0.43**	**-0.67**	**0.27**						
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
(7)	PPEAssets	**0.03**	**0.04**	**0.26**	**-0.26**	**0.22**	**0.20**					
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)					
(8)	Leverage	-0.01	**-0.08**	**0.22**	**-0.14**	**0.17**	**0.01**	**0.30**				
		(0.30)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.00)				
(9)	CapexAssets	**0.09**	**0.04**	**0.07**	**-0.06**	**-0.03**	**0.13**	**0.58**	**0.07**			
		(0.00)	(0.00)	(0.00)	(0.00)	(-0.05)	(0.00)	(0.00)	(0.00)			
(10)	MtoB	**0.11**	**-0.02**	**-0.15**	**0.34**	**-0.21**	**-0.14**	**-0.18**	**-0.14**	**0.05**		
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		
(11)	Analysts	**0.20**	**-0.16**	**0.57**	**-0.07**	**0.20**	**0.18**	-0.00	-0.00	-0.00	**0.06**	
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.83)	(0.48)	(-0.64)	(0.00)	
(12)	Instit Owners	**0.06**	**-0.08**	**0.48**	**-0.18**	**0.26**	**0.29**	**0.02**	**0.02**	-0.01	**-0.06**	**0.43**
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.13)	(0.00)	(0.00)

Panel C: Distribution by industry

Fama French Industry	Mean Cites$_{t+3}$	# Obs
Business Services	99.23	2,193
Electronic Equipment	215.48	1,946
Pharmaceutical Products	79.89	1,763
Medical Equipment	111.71	1,119
Machinery	109.25	1,106
Computers	254.16	1,080
Measuring and Control Equipment	104.28	704
Electrical Equipment	65.75	505
Chemicals	69.27	498
Consumer Goods	161.37	450
Construction Materials	31.89	433
Automobiles and Trucks	211.39	432
Petroleum and Natural Gas	224.76	374
Business Supplies	190.28	329
Wholesale	9.85	320
Retail	10.13	289
Communication	186.78	264
Food Products	18.27	263
Rubber and Plastic Products	7.31	247
Recreation	104.80	244
Apparel	31.88	232
Steel Works	23.91	214
Aircraft	257.37	157
Healthcare	21.37	155
Transportation	11.98	152
Textiles	13.45	94
Personal Services	1.88	83
Shipping Containers	26.56	82
Entertainment	276.53	79
Defense	184.48	77
Restaurants, Hotels, Motels	9.83	72
Fabricated Products	2.21	70
Construction	5.79	68
Printing and Publishing	1.90	68
Beer & Liquor	193.42	57
Candy & Soda	40.97	35
Non-Metallic and Industrial Metal	23.74	27
Shipbuilding, Railroad Equipment	61.83	23
Precious Metals	1.05	20
Agriculture	266.13	16
Total	120.51	16,340

TABLE 3
The association between disclosure quality and innovation (H1)

This table presents the OLS regression results for the association between disclosure quality and innovation, where innovation is proxied by patent citations (*LnCites*$_{t+3}$). In column 2, patent citations is replace with patent quantity, *LnCounts*$_{t+3}$. In column 3, patent quality in year *t+3* is replaced with patent quality in year *t+1*. See Appendix A for variable definitions. The regressions include firm and year fixed effects. *t*-statistics are in parentheses. Standard errors are clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

	(1) *LnCites* $_{t+3}$	(2) *LnCounts*$_{t+3}$	(3) *LnCites* $_{t+1}$
DQ$_t$	**0.026****	**0.019*****	**0.023****
	(2.185)	**(3.035)**	**(1.963)**
LnAssets$_t$	0.040	0.110***	0.232***
	(0.934)	(4.545)	(5.881)
RDAssets$_t$	0.380	0.197	0.543**
	(1.351)	(1.341)	(2.058)
NoRDexp$_t$	-0.083	0.046	-0.111
	(-0.778)	(0.861)	(-1.038)
LnFirmAge$_t$	0.040	-0.023	-0.023
	(0.351)	(-0.389)	(-0.214)
ROA$_t$	0.283**	0.142**	0.058
	(2.155)	(2.122)	(0.469)
Leverage$_t$	-0.383***	-0.163***	-0.409***
	(-3.326)	(-2.767)	(-3.687)
PPEAssets$_t$	0.412	0.235*	0.172
	(1.610)	(1.684)	(0.652)
CapexAssets$_t$	0.799*	0.009	0.112
	(1.871)	(0.039)	(0.265)
MtoB$_t$	0.035***	0.018***	0.062***
	(3.774)	(3.886)	(6.736)
LnAnalysts$_t$	-0.041*	0.002	-0.017
	(-1.823)	(0.153)	(-0.743)
Instit Owners$_t$	-0.114	0.036	0.045
	(-1.005)	(0.600)	(0.425)
Observations	16,340	16,340	21,037
Adjusted R^2[%]	77.0	87.3	73.7

TABLE 4
The simultaneous relation between disclosure quality and innovation

This table presents the results for the Granger causality tests. See Appendix A for variable definitions. The regressions include firm and year fixed effects. *t*-statistics are in parentheses. Standard errors are clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

	(1) $LnCites_{t+3}$	(2) $LnCounts_{t+3}$	(3) $LnCites_{t+1}$	(4) DQ_{t+3}	(5) DQ_{t+3}
$\boldsymbol{DQ_t}$	0.031**	0.018***	0.024**	-0.079***	-0.080***
	(2.479)	(2.719)	(2.173)	(-5.905)	(-5.916)
DQ_{t-1}	0.010	0.007	0.025**	-0.073***	-0.073***
	(0.756)	(0.942)	(2.281)	(-5.719)	(-5.711)
$LnCites_t$	0.071***		0.209***	0.001	
	(6.107)		(16.998)	(0.122)	
$LnCites_{t-1}$	0.008		0.126***	-0.005	
	(0.781)		(12.119)	(-0.646)	
$LnCounts_t$		0.128***			-0.010
		(8.309)			(-0.505)
$LnCounts_{t-1}$		0.015			-0.014
		(1.215)			(-0.743)
Controls	YES	YES	YES	YES	YES
Observations	14,269	14,269	18,351	12,438	12,438
Adjusted R^2[%]	78.7	88.3	77.5	30.2	30.2

TABLE 5
Rebuilding trust following Arthur Andersen's demise

This table presents the difference-in-differences test around Arthur Andersen's demise, where the treatment sample is composed of firms that were audited by Arthur Andersen in 2001 whose disclosure quality improved following the move to a new auditor. *post_scandal* is an indicator variable that equals one for fiscal year 2003 and zero for fiscal year 2001. *DQimprove* is an indicator variable that equals one for firms whose disclosure quality improved when they switched auditors following Arthur Andersen's closure and zero for firms that did not change auditors. This variable is subsumed by the firm fixed effects. *post_scandal*×*DQimprove* is the interaction term of *post_scandal* and *DQimprove*. Columns 3-6 present the results for pseudo scandal years. *post_scandal* is shifted back by two years and one year in columns 3 and 4 respectively. *post_scandal* is shifted forward by one and two years in columns 5 and 6 respectively. The regressions include firm and year fixed effects. *t*-statistics are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)
			Pseudo scandal 2000	Pseudo scandal 2001	Pseudo scandal 2003	Pseudo scandal 2004
	DQ	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$
post_scandal×*DQimprove*	0.864***	**0.376*** **	**0.017**	**0.225**	**0.071**	**0.162**
	(6.778)	**(2.695)**	**(0.137)**	**(1.605)**	**(0.488)**	**(1.074)**
post_scandal	-0.094	-0.483***	0.072	1.287	-0.540***	0.229
	(-1.264)	(-6.697)	(0.226)	(1.077)	(-6.924)	(0.495)
Controls	YES	YES	YES	YES	YES	YES
Observations	2,462	2,198	1,828	2,011	2,264	2,246
Adjusted R^2[%]	32.8	85.7	86.9	84.8	84.5	83.1

TABLE 6
Rebuilding trust following trust-deteriorating restatements

This table presents the difference-in-differences around trust-deteriorating restatements. *post_Res* is an indicator variable that equals one for the three years following a restatement due to material weakness or fraud, and is zero for the three years before the restatement. *post_Res×DQ* is the interaction term of *post_Res* and financial disclosure quality. In both columns, the samples include the firms that had the trust-deteriorating restatement and matched firms that did not report a restatement in the relevant period. In columns 1 and 3-6, the matching is based on fiscal year and size (total assets). In column 2, the matching is based on fiscal year, size, and disclosure quality in the year before the restatement. Columns 3-6 present the results for pseudo restatement years. *post_Res* is shifted back by three years and two year in columns 3 and 4 respectively. *post_Res* is shifted forward by two and three years in columns 5 and 6 respectively. The regressions include firm and year fixed effects. *t*-statistics are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

	(1)	(2) Matching includes pre-*DQ*	(3) Pseudo restatement 3 years prior	(4) Pseudo restatement 2 year prior	(5) Pseudo restatement 2 years post	(6) Pseudo restatement 3 years post
	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$	$LnCites_{t+3}$
post_Res×DQ	0.199**	0.152**	0.227	0.069	0.021	0.079
	(2.034)	(1.975)	(1.244)	(0.614)	(0.281)	(0.900)
post_Res	0.150	0.020	0.078	-0.029	-0.005	-0.046
	(0.745)	(0.133)	(0.269)	(-0.135)	(-0.030)	(-0.254)
Controls	YES	YES	YES	YES	YES	YES
Observations	430	624	181	257	500	482
Adjusted R^2[%]	81.7	83.1	85.7	84.4	82.4	80.8

TABLE 7
Cross-sectional tests (H2)

This table presents the regression results for cross-sectional tests of conditions that influence the relation between innovation and disclosure quality. In column 5, the sample if limited to firms that report a loss. See Appendix A for variable definitions. The regressions include industry, firm, and year fixed effects. *t*-statistics are in parentheses. Standard errors are clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

	(1) $LnCites_{t+3}$	(2) $LnCites_{t+3}$	(3) $LnCites_{t+3}$	(4) $LnCites_{t+3}$	(5) $LnCites_{t+3}$
DQ_t × *RegFD*	0.079***				
	(2.655)				
RegFD	-2.030***				
	(-19.639)				
DQ_t × *illiquidity*		1.426***			
		(3.079)			
$Illiquidity_t$		1.024***			
		(2.948)			
DQ_t × *LnAssets*			0.027***		
			(3.890)		
DQ_t × $NoRDexp_t$				-0.102***	
				(-3.494)	
DQ_t	-0.028	0.046***	-0.150***	0.050***	0.051**
	(-1.038)	(3.377)	(-3.264)	(3.582)	(2.298)
$LnAssets_t$	0.039	0.052	0.043	0.040	0.016
	(0.872)	(1.146)	(1.013)	(0.938)	(0.241)
$NoRDexp_t$	-0.119	-0.108	-0.082	-0.067	0.318
	(-1.042)	(-0.976)	(-0.766)	(-0.631)	(1.415)
Controls	YES	YES	YES	YES	YES
Observations	14,794	15,422	16,340	16,340	5,648
Adjusted R^2[%]	0.767	0.770	0.771	0.771	0.722

TABLE 8
The effect of generalized trust (H2)

This table presents the OLS regression results for the association between disclosure quality and innovation, when the sample is partitioned by State-level generalized trust. Generalized trust is investors' general willingness to give trust (irrespective of the firm's efforts to inspire trust), which is measured by surveys (Neville 2012). In columns 1 and 3, the sample is of firms with headquarters in states with high generalized trust. In columns 2 and 4, the sample is of firms with headquarters in states with low generalized trust. In columns 3 and 4, patent citations is replace with patent quantity, $LnCounts_{t+3}$. See Appendix A for variable definitions. The regressions include industry, firm, and year fixed effects. *t*-statistics are in parentheses. Standard errors are clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

	(1) High Trust $LnCites_{t+3}$	(2) Low Trust $LnCites_{t+3}$	(3) High Trust $LnCounts_{t+3}$	(4) Low Trust $LnCounts_{t+3}$
$\boldsymbol{DQ_t}$	**0.038****	**0.014**	**0.024****	**0.013**
	(2.111)	**(0.834)**	**(2.455)**	**(1.632)**
$LnAssets_t$	-0.033	0.109**	0.041	0.174***
	(-0.493)	(1.968)	(1.135)	(5.450)
$RDAssets_t$	0.433	0.284	0.244	0.135
	(1.020)	(0.746)	(1.145)	(0.675)
$NoRDexp_t$	-0.104	-0.088	0.128*	-0.029
	(-0.696)	(-0.563)	(1.745)	(-0.374)
$LnFirmAge_t$	0.216	-0.132	0.037	-0.072
	(1.290)	(-0.817)	(0.452)	(-0.864)
ROA_t	0.382*	0.246	0.247**	0.063
	(1.869)	(1.399)	(2.376)	(0.714)
$Leverage_t$	-0.296*	-0.400**	-0.125*	-0.201**
	(-1.894)	(-2.287)	(-1.666)	(-2.134)
$PPEAssets_t$	0.372	0.537	0.357	0.144
	(0.918)	(1.587)	(1.637)	(0.785)
$CapexAssets_t$	1.313*	0.400	0.217	-0.117
	(1.852)	(0.728)	(0.596)	(-0.437)
$MtoB_t$	0.028**	0.041***	0.020***	0.019***
	(2.051)	(3.139)	(3.002)	(2.902)
$LnAnalysts_t$	0.000	-0.079***	0.014	-0.008
	(0.002)	(-2.670)	(0.740)	(-0.513)
$Instit\ Owners_t$	-0.083	-0.170	0.095	-0.047
	(-0.465)	(-1.136)	(1.085)	(-0.589)
Observations	7,790	8,111	7,790	8,111
Adjusted R^2[%]	0.763	0.771	0.868	0.874

TABLE A1
Patent users: Selection bias

This table presents the results of the two-stage Heckman analysis. The first-stage Probit regression results are presented in column 1. The Inverse Mills Ratio calculated in the first stage is included in the regressions in columns 2 and 3. Innovation is measured as patent quantity (*LnCounts*) in column 2 and patent quality (*LnCites*) in column 3. See Appendix A for variable definitions. In column 1, the regression includes industry and year fixed effects. *Z*-statistics are in parentheses. In columns 2 and 3, the regressions include industry, firm, and year fixed effects. *t*-statistics are in parentheses. Standard errors are clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

	(1) $UsesPatents_t$	(2) $LnCounts_{t+3}$	(3) $LnCites_{t+3}$
$TradeSecretProt_t$	0.058		
	(1.007)		
OS $Prospector_t$	0.181***		
	(6.990)		
OS $Defender_t$	-0.115***		
	(-5.550)		
DQ_t		0.021***	0.047***
		(2.687)	(3.167)
IMR_t		0.250	-0.343
		(1.064)	(-0.801)
$LnAssets_t$	0.189***	0.148***	0.006
	(36.732)	(3.928)	(0.089)
$RDAssets_t$	0.899***	0.175	0.023
	(13.785)	(1.000)	(0.070)
$NoRDexp_t$	-0.627***	-0.033	-0.027
	(-33.205)	(-0.286)	(-0.134)
$LnFirmAge_t$	0.225***	0.018	-0.008
	(21.229)	(0.231)	(-0.054)
ROA_t	0.140***	0.096	0.241*
	(4.904)	(1.340)	(1.756)
$Leverage_t$	-0.098***	-0.111*	-0.166
	(-7.178)	(-1.859)	(-1.325)
$PPEAssets_t$	-0.143***	0.280	0.484
	(-2.649)	(1.570)	(1.461)
$CapexAssets_t$	-0.145	0.086	0.826*
	(-1.052)	(0.359)	(1.783)
$MtoB_t$	0.017***	0.010**	0.015**
	(9.738)	(2.163)	(2.082)
$LnAnalysts_t$	0.129***	0.025	-0.054
	(19.395)	(1.037)	(-1.261)
Instit $Owners_t$	-0.003	0.006	-0.095
	(-1.265)	(0.088)	(-0.708)
Observations	42,690	11,026	11,026
Pseudo R^2[%]	30.2		
Adjusted R^2[%]		87.2	77.1

TABLE A2
Two-stage least squares

This table presents the two-stage least squares (2SLS) estimation results. Columns 1-3 describe results with innovation based on patent applications in year *t+1*, and columns 4-6 describe results with innovation based on patent applications in year *t+3*. Columns 1 and 4 present the results for the first stage of the 2SLS; columns 2 and 5 present the results for the second-stage regression with patent quantity; and columns 3 and 6 present the results for the second-stage regression with patent quality. See Appendix A for variable definitions. The regressions include industry and year indicator variables. Standard errors are heteroskedasticity-robust. *Z*-statistics are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)
	Sample: patents in *t+1*			Sample: patents in *t+3*		
	1st stage	2nd stage	2nd stage	1st stage	2nd stage	2nd stage
	DQ_t	$LnCounts_{t+1}$	$LnCites_{t+1}$	DQ_t	$LnCounts_{t+3}$	$LnCites_{t+3}$
Predicted DQ_t		2.248***	2.480***		2.045***	2.197***
(from 1st stage)		(4.303)	(3.767)		(3.777)	(3.318)
Sales Vol$_t$	-0.138***			-0.141***		
	(-4.780)			(-4.310)		
LnAssets$_t$	-0.191***	0.913***	1.093***	-0.184***	0.856***	0.990***
	(-31.950)	(9.075)	(8.651)	(-27.310)	(8.518)	(8.076)
RDAssets$_t$	-0.123	2.197***	2.764***	-0.045	1.976***	2.487***
	(-1.590)	(10.675)	(10.475)	(-0.50)	(9.303)	(9.184)
NoRDexp$_t$	0.074**	-0.774***	-1.087***	0.059*	-0.749***	-0.996***
	(3.360)	(-12.024)	(-13.707)	(2.360)	(-11.768)	(-13.016)
LnFirmAge$_t$	0.082***	-0.133**	-0.195***	0.076***	-0.102*	-0.145**
	(6.980)	(-2.449)	(-2.888)	(5.860)	(-1.910)	(-2.223)
ROA$_t$	0.45***	-0.823***	-0.850***	0.464***	-0.673***	-0.580*
	(10.590)	(-3.422)	(-2.771)	(9.30)	(-2.645)	(-1.844)
Leverage$_t$	-0.286***	0.410**	0.263	-0.304***	0.378*	0.274
	(-7.140)	(2.249)	(1.158)	(-6.270)	(1.873)	(1.119)
PPEAssets$_t$	0.382***	-1.302***	-1.786***	0.328***	-1.208***	-1.613***
	(5.840)	(-4.748)	(-5.263)	(4.420)	(-4.606)	(-5.123)
CapexAssets$_t$	-0.743**	3.293***	4.970***	-0.676**	3.342***	5.220***
	(-3.370)	(4.726)	(5.720)	(-2.720)	(4.802)	(6.168)
MtoB$_t$	0.003	0.077***	0.141***	-0.001	0.092***	0.146***
	(0.770)	(7.273)	(10.435)	(-0.210)	(8.461)	(10.754)
CF Vol$_t$	-0.101	0.664***	1.005***	-0.096	0.527*	0.728**
	(-1.220)	(2.681)	(2.961)	(-0.960)	(1.958)	(2.028)
Sales Growth$_t$	-0.041*	-0.015	0.039	-0.03	-0.033	-0.008
	(-2.320)	(-0.326)	(0.666)	(-1.520)	(-0.718)	(-0.147)
Stock Return$_t$	-0.006	-0.004	-0.026	-0.008	0.003	-0.014
	(-0.720)	(-0.173)	(-0.950)	(-0.760)	(0.134)	(-0.480)
Litigation Risk$_t$	-0.057*	0.232***	0.298***	-0.048	0.244***	0.286***
	(-2.020)	(3.050)	(3.179)	(-1.510)	(3.165)	(3.112)
LnAnalysts$_t$	0.011	0.077***	0.093***	0.022**	0.070***	0.081***

	(1)	(2)	(3)	(4)	(5)	(6)
	Sample: patents in *t+1*			Sample: patents in *t+3*		
	1st stage	2nd stage	2nd stage	1st stage	2nd stage	2nd stage
	DQ_t	$LnCounts_{t+1}$	$LnCites_{t+1}$	DQ_t	$LnCounts_{t+3}$	$LnCites_{t+3}$
	(1.530)	(4.292)	(4.234)	(2.690)	(3.230)	(3.130)
Instit Owners$_t$	-0.118***	0.051	0.179	-0.133***	0.094	0.129
	(-3.940)	(0.562)	(1.592)	(-3.880)	(0.929)	(1.065)
Observations	20,426	20,426	20,426	15,774	15,774	15,774
F-Statistic	64.52	51.37	86.06	48.30	50.02	76.04