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INFORMATION ENVIRONMENT AND CORPORATE INNOVATION: A SURVEY

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Abstract

A field of research that attracts increasing attention from scholars is the impact of the information environment on corporate innovation. In this article, I review the research from three points of view in relation to the information environment: (i) managers' voluntary disclosure, (ii) disclosure mandated by regulation, and (iii) information intermediaries (media and analysts). Research suggests that the information environment generally plays both positive and negative roles in corporate innovation by affecting effort and efficiency through different mechanisms. Finally, I put forward some suggestions on two aspects of future research directions of this field.

Keywords: information environments, media coverage, and firm innovation

JEL Classification: G14, G32, O31

Contents

1. INTRODUCTION

I study existing research on the three different aspects which influence the commercial information environment: (i) the manager's intended disclosure, (ii) disclosure authorized by regulation, and (iii) information intermediaries (Beyer et al. 2010).

First, the internal human resources, that is, entrepreneurs or managers, have an incentive to disclose information voluntarily. There are two reasons for the endogenous development of the information environment: the information asymmetry between creditors and shareholders with investment demand and the agency problem (principal–agent theory) between agents and principals triggered by the division of ownership and administration privileges.

Second, when managers fail to take the initiative and disclose all the private information, capital markets have the right to demand disclosure regulation. The literature on information disclosure regulation provides two main reasons. The reasons include the inconsistencies in the motivation of insiders and investors, which may lead to a lack of credibility of the information that managers deliver. From this perspective, disclosure requirements, accounting principles, auditors, and Securities and Exchange Commission (SEC) oversight are methods which force companies to pledge to specific stages of disclosure and increase their integrity. Additionally, the disclosure of confidential information can lead to the problem of free-riding behavior due to a lack of adequate motivation for managers to voluntarily disclose information, although additional details can improve corporate social welfare. In this case, the regulation and mandatory disclosure of specific information can have spillover effects, which is desirable. Therefore, the capital market needs disclosure regulation, although the corporate information environment is endogenous.

Similarly, existing literature suggests that information intermediaries (media and analysts) undertake an essential role in shaping the information environment.

Firm innovation is an important subject that attracts massive attention from researchers in the finance sector. The emphasis is due to the ability of technological innovation to have a profound influence on the competitive advantage of a firm and the long-run growth of the national economy (Solow 1957; Romer 1986; Porter 1992).

A 2015 report by the Organisation for Economic Co-operation and Development (OECD) states that innovation accounts contribute approximately 50% of the total GDP growth of a country and their impact differs according to the economic development and financial cycle of the nation. Rosenberg (2004) estimates that more than half of a country's economic growth can be attributed to technological innovation. Chang et al. (2016) illustrate that the one-standard deviation increase in per capita patent stock is related to the growth of 0.85% of GDP. From this perspective, the larger number of financial economists set out to explore the determinants of innovation at the corporate, market, and national levels. Furthermore, the increasing literature on innovation is inseparable from the establishment of the high-quality patents and citation databases that have captured the innovative output of a country or company over the past decade.

Moreover, comprehending the economic outcomes of an organization's information environment is an essential subject in financial study. This paper reviews both the theoretical and empirical research analyzing the effects of a company's information environment on corporate innovation and discusses the mechanisms underlying these effects.

Several vital studies illustrate the relationship between the information environment and corporate innovation and the underlying mechanisms. According to these researches, the information environment plays both positive and negative roles in corporate innovation.

He and Tian (2013) find the adverse causal effects of the information environment on corporate innovation from the analyst coverage point of view. With a large number of analysts following a company, the company produces few patents. They hold the view that analysts put agents in a high-pressure environment to focus and achieve short-period targets and profitability, which affects investment in and performance on innovative projects and also hinders long-term growth.

According to Dai et al. (2018), an adverse correlation exists between media reporting and corporate innovation. Additionally, they suggest that two economic mechanisms cause the impact: excessive pressure on managers and knowledge spillovers to competitors.

However, other documents illustrate the positive role and the underlying mechanisms of the information environment in promoting innovation incentives and results.

Zhong (2018) elaborates that a transparent information environment directly stimulates innovation by reducing managers' worries about their careers. He argues that the implicit contractual role of the information environment reduces the turnover rate of managers when innovation results are not satisfying. Transparency also increases innovation output through its governance role in enabling the effective distribution of research and development (R&D) resources.

Similarly, Brown and Martinsson (2019) explore how transparency in the corporate information environment promotes innovation. They find that there is an observable augmentation in R&D and patenting rates in a productive information environment. Moreover, they also find that the impact of transparency is most pronounced in industries that rely on external equity rather than bank debt, suggesting that transparency promotes innovation by reducing the information costs associated with independent financing. Therefore, they argue that corporate transparency lessens information asymmetry between enterprises and the external capital market.

Lastly, Guo et al. (2019) analyze the relationship between financial analysts and corporate innovation strategy and output. They provide evidence which shows an upsurge in the number of financial analysts, which causes companies to reduce R&D spending, merge more innovative firms, and increase investment in venture capital. They argue that analysts inspire companies to invest adequately in innovation, which causes their future innovative performance to surge and even affects the originality of their innovation strategies.

How does a firm's information environment affect innovation? I review the existing literature that discusses the impacts of the information environment on innovation. In particular, I divide the positive effects into two dimensions: innovation effort and innovation efficiency. Innovation effort is determined by external financial constraints and the manager's incentive to invest in novel activities, which can be evaluated through the firm's innovative spending. On the other hand, innovation efficiency is defined by the selection and outcomes of innovation projects, which can be calculated using patents or citations (He and Tian 2013). Similarly, I divide the adverse effects into two classifications: the pressure effect and knowledge leakage. The pressure impact indicates that a transparent information environment may put an excessive burden on managers, causing them to invest in projects that bring short-term benefits or cut back on innovative activities. Knowledge leakage means that the transparent

information environment will threaten the patent achievements of companies and reveal the innovative accomplishments to competitors, which may result in massive investment losses.

This survey comprises four sections. The first part reviews the literature that introduces the different aspects of the information environment and the importance of innovation as well as some key literature that illustrates the relationship between the information environment and corporate innovation. Section 2 covers studies analyzing the positive role of the information environment in corporate innovation (such as the positive effect on innovation effort and innovation efficiency). Section 3 examines the literature on how the information environment impedes innovation through the channels of the pressure effect and knowledge leakage. Finally, I put forward our suggestions for future research directions.

2. THE POSITIVE ROLE OF THE INFORMATION ENVIRONMENT

Previous studies have shown that a transparent information environment can improve corporate innovation efforts by reducing external financial constraints and motivating internal management incentives.

2.1 Information Environment and Innovation Effort

Research and development are likely to encounter the dilemma of insufficient investment due to external financial constraints and lack of internal management motivation (Brown et al. 2013; Hall 2002). By minimizing information asymmetry between enterprises and the external capital market, the information environment decreases the cost of capital and broadens the company's financing channels. Additionally, the information environment helps solve the conflict between managers and principles by improving the measurement of managers' performance.

2.1.1 Mitigation of External Financial Constraints

A World Bank Enterprise survey conducted for about four years shows that approximately 40% of companies consider inadequate financing as the primary problem in their operation and development. Innovation is a procedure which depletes internal equity and easily creates ambiguity that hinders efficient communication with external investors (Bhattacharya and Ritter 1983). Therefore, innovative organizations are severely affected by limited external funding. Furthermore, innovation has a significant failure rate (Holmstrom 1989). Companies that attach great importance to innovative project financing have significant information asymmetry with external capital markets and encounter severe financing constraints (Bhattacharya and Ritter 1983). The difficulty of delivering the desired predictions for long-term projects to the market causes some companies to imitate other organizations' investment decisions, creating the lemon problem. Prospering corporations either overinvest as a signal (Bebchuk 1993) or severely underinvest, depending on market preferences (Brandenburger and Polak 1996).

Hall (2002) surveys the evidence on R&D "funding gaps", focusing on the causes of insufficient innovation investment in financial markets, which will persist even without external factors. The study concludes that first, the high cost of capital of emerging innovative firms is partially moderated by the presence of investment equity, and second, methods of solving the funding gap in investment capital are limited, especially on the

public stock markets of countries that are not well developed. This article also discusses innovation investment in the case of market failure. There exists a block, even a significant one, between the required investment return rate of entrepreneurs for investing their private capital and that of outside investors. According to this view, some innovations are funded only when the investor has made a profit or the company shows a profit, because the cost of capital from outside investors is much higher, despite the return rate on the innovation project attaining some threshold of private gain.

The information environment provides a potential solution to this financial difficulty by transmitting the company's internal information to the public. It also increases the visibility and credibility of managers (Milbourn 2003). Both impacts provide companies with more access to capital and lower their financial costs.

Efficient interaction between internal management and external investors through media can enhance information transparency, improve visibility, and solve financial constraints. Previous researches have detailed the impact of media reports on share prices by passing on internal information to the public. Additionally, the media help attract partners and provide credibility for their investment decisions and viability due to the increased popularity of managers. Similarly, recent studies have shown that media reporting reduces financing and transaction costs (Fang and Peress 2009; Bushee, Core, Guay, and Hamm 2010; Blankespoor, Miller, and White 2014; Bushman, Williams, and Wittenberg-Moerman 2017).

Brown and Martinsson (2019) prove that there is a significant positive relationship between the information environment and corporate innovation. The benefits of excellent transparency of financial markets are widely acknowledged in theory and practice. Nevertheless, the net influence of the information environment is ambiguous. The main benefits of a transparent information environment – reduced information asymmetry and lower independent financing costs – are particularly important for investment in innovation since the nature of R&D makes it more equity-based and information-sensitive than fixed-asset investments. Using different measures of a country's degree of corporate transparency, Brown and Martinsson (2019) find supportive evidence that the more transparent the information environment, the higher the degree of R&D and patent citations in industries that rely on external equity financing. They also point to the first prosecutions of internal trading and the implementation of transparency rules in the European securities market as quasi-experimental shocks to a broad information environment in an economy. The information shocks have also led to a surge in R&D. However, a transparent information environment has little or no impact on the rate of fixed capital accumulation, which is consistent with degree of information asymmetry of tangible assets which is lower than the level of innovation.

Generally, research shows that innovative companies depend on expensive equity as their preferred source of financing. A series of works in the literature indicate that, by reducing information friction, a transparent information environment can theoretically reduce the equity cost of companies and improve their access to external funding to provide the impetus for companies' investment in innovation.

2.1.2 Inspiration for Internal Management Incentives

In addition to reducing financing constraints, emerging research shows that a productive information environment can change managers' risk preferences and motivate them to make efforts to innovate by reducing their career risk.

The literature also suggests that external financing alone may not stimulate innovation efforts. Additionally, due to lack of financial constraints, risk-averse managers will oppose

innovative projects that have a long-period investment and a high rate of failure.

In standard agency frameworks, subjects cannot directly observe agents' behavior. Therefore, they must depend on noticeable after-the-fact indications such as project productivity to evaluate managers' performance. However, outcome-based measures are often ambiguous. Thus, the evaluation does not account for specific management activities undertaken to attain set goals (Armstrong et al. 2010). Therefore, agents are unwilling to choose high-risk and long-term innovative programs, because when these programs fail, they will bear the full career consequences.

In this case, explicit contracts do not completely solve the motivation challenge since they are characteristically unfinished and also do not depict the actual marginal outcomes of management innovation efforts. For example, profit-based contracts fail to foster innovation because R&D investments have a multi-level impact, which is not fully reflected in current returns. Although studies show that stock prices can better describe long-term value development, stock prices contain aggregate public and private information, limiting their worth in measuring managers' ongoing contributions (Bushman and Smith 2003), and standard performance-based compensation schemes with low tolerance to early failure may intensify management short-sightedness and hinder innovation (Manso 2011). Additionally, the periods of explicit contracts of public companies' executives are usually very short, so they are unlikely to protect them from the occupational risks of failed innovations (Aghion et al. 2013). The remuneration of most managers is therefore determined not through contracts but by the client's perception of his or her ability to renegotiate agreements. Holmstrom (1989, 1999) indicates that one possible remedy would be to monitor management actions closely and use these details to solve the drawbacks of explicit contracting. Although comprehensive observations of management behavior are either unrealistic or very expensive, high-quality financial information can provide company leaders with extra facts about management conduct to better identify management efforts (Armstrong et al. 2010). The financial information, for example, detailed company-specific advantage analysis, can help investors evaluate managers' risk preference, strategic insight, and investment decisions, contributing to a better comprehension of the relationship between managers' behavior and the results of innovation. It can also help separate market noise in the measures of outputs and avoid unnecessary punishment of managers. As a result, managers of various transparent companies are motivated to innovate more to reduce career risks in the multi-period contractual relationship.

By using an identification method based on a fixed effect model to analyze a panel dataset at the level of large companies, which includes the annual observation data of 12,930 listed companies in 29 countries for approximately 20 years, Zhong (2018) finds that the information environment directly spurs innovative effort by reducing managers' concerns about career risks. He builds the dataset by matching World scope's financial data with The United States Patent and Trademark Office (USPTO) patent data at the company level. He uses this novel dataset of corporate patent matches at the international micro-level to conduct comprehensive analysis at the national level and examine the effect of the company's information environment on its innovation incentives and results. The multi-dimensional (country, company, year) form of the dataset also allows him to control for a large number of missing variables. His analysis leads to two main conclusions. First, he provides strong evidence that corporate transparency significantly improves the management of R&D investments, even after controlling external funding channels. The outcomes apply to six corporate-stage measures of transparency, which entail several calculations of financial reporting quality (Leuz et al. 2003), one measure using global accounting principles (Daske et al. 2013) and two using

external information environment measures, that is, the quality and accuracy of analyst coverage and forecasts. Second, he suggests that transparency promotes R&D by reducing management's sensitivity to poor innovation outcomes, and by its implicit contractual role. The findings of his cross-sectional studies show that when managers face significant career risks from investing in innovation projects, for example, if they serve in companies with low private ownership or long product development cycles, the incremental impact of transparency on innovation investment is significant.

In conclusion, due to internal managerial incentives and external financial constraints, innovative activities are often underfunded. When choosing investment projects, managers tend to give up investing in R&D projects to avoid risks because their risks are uncertain compared to fixed capital investments (Kothari et al. 2002). Additionally, if innovation fails due to purely random factors, managers will bear all the career consequences (Hirshleifer 1993; Kaplan and Minton 2012). A transparent information environment can help managers avoid unreasonable career risks by offering well documented organization-specific information on managerial actions. It can also help them filter out noise from unpredictable market risks (Bushman and Smith 2001). From this perspective, a transparent information environment can change managers' risk preferences and put more effort into innovation.

2.2 Information Environment and Innovation Efficiency

A transparent information environment can spur corporate innovation by improving a manager's ability to select high-potential innovative projects and providing excellent external and internal governance.

2.2.1 Innovation Project Selection

A transparent information environment can stimulate corporate innovation by enhancing the manager's capability to choose innovative programs with high potential. First, according to Beyer et al. (2010), high-quality external information can immediately assist agents in making investment decisions since they convey the prospect of future growth. The facts also help managers estimate the return on investment chances (Hemmer and Labro 2008). Second, the selection of innovation projects is a critical step in achieving extreme innovation effectiveness. However, greater innovation efforts do not necessarily translate into superior innovation efficiency. There is no specific positive correlation between a given research input level and innovation output (Hirshleifer et al. 2013). The complexity, the long-term commitment to resource investment, and the consequences of high uncertainty often overshadow the choice of innovation projects. Therefore, accomplishing the selection of an innovation project relies on the accessibility of valued information which can be measured and merged into the decision (Meade and Presley 2002). Importantly, false information can produce idealistic prospects for future development and alter the company's actual choices (McNichols and Stubben 2008). By reflecting on firm values and management performances, a transparent information environment directly determines the selection of innovation projects. Thirdly, by supporting the role of information in stock prices, managers can be guided to determine innovative investment choices through learning channels. According to various works in the literature, managers can improve their investment decisions by learning about the prospects of their companies from private information on stock prices. Transparency can improve the efficiency of stock prices in transmitting such information, thus enhancing the capability of managers to understand investment opportunities (Loureiro and Taboada 2015). Since the stock price feedback mainly reflects the market demand for

the company's possible products or the opposition from other companies, the impact on innovation is significant (Chen et al. 2007).

Guo et al. (2019) analyze the impact of analyst coverage on the strategy for selection of innovation projects. They state that companies tracked by a great many financial analysts are observed to cut back on internal research and development projects. Also, these companies are inclined to start or increase corporate venture capital (CVC) investments and to acquire other innovative companies. Although cutting R&D spending hurts firms' future innovation output (lower innovation quantity), it also helps in producing more patents and citations (higher innovation quality) after being tracked by financial analysts. Similarly, a company's investments in acquisitions and CVC funds, which lead to breakthrough innovation, have a positive impact on the future innovation output. These results suggest that financial analysts drive companies to make effective decisions on innovation. According to Guo et al. (2019), coverage by analysts can cause companies to cut internal innovation spending, which is reflected in those projects with low production efficiency or waste. Reducing internal R&D is effective and contributes to long-term innovation performance. Furthermore, they argue that when unnecessary R&D spending is reduced, innovation output is likely to increase by allowing investors to focus on the most efficient projects. At the same time, increased acquisition and CVC investment should help these companies develop and acquire new technologies to improve their absorption capacity. Therefore, they think, under the attention of analysts, the company's long-term innovation performance is better.

2.2.2 External and Internal Governance

A transparent information environment can provide high-quality external and internal governance that improves the performance of managers when investing in innovation.

There are several reasons that explain why improved project identification may fail to ensure efficient resource allocation. First, because of the agency problem, according to Greenspan (2002), intangible investment is more prone to company malfeasance than tangible investment. Selfish managers with lots of stock options may emphasize risky innovation projects to chase short-term profits. They may also take advantage of the high degree of information asymmetry related to R&D to obtain secret profits from internal trading (Aboody and Lev 2000). Second, due to the intangible nature of innovation projects, it is challenging for investors to spot and inspect management misconduct. The characteristics of R&D also limit the capacity of investors to acquire information about the efficiency or value of their innovation programs by perceiving the innovation performance of other companies (Aboody and Lev 2000).

A transparent information environment can provide firm-oriented financial information that assists in external and internal governance, constraining managers to ensure prudent use of R&D funds. For example, high-quality information through monitoring can reduce opportunistic mismanagement of R&D funds and reduce costs. Moreover, it helps financial principals prevent market noise in various measures and avoids unnecessary punishment of managers (Bushman and Smith 2001). Although the innovation output can only observe the final result, a transparent information environment can allow principals to better observe how the manager realizes this performance.

Busman and Smith (2001) mainly study the governance role of financial accounting information. Their study also discusses worldwide research on the impact of financial accounting information on economic performance and proposes a theoretical framework to describe and measure corporate transparency at the national level. According to this framework, they separate the three channels through which financial accounting

information affects business investment, productivity, and value added. The first channel involves managers and investors using financial accounting information to identify projects with investment potential. The second channel is the application of financial accounting information in corporate governance mechanisms. Through financial accounting information, managers can concentrate their resources in investment in high-quality projects. The third channel is to use financial accounting information to improve the information asymmetry among investors. They elaborate on the use of accounting information based on economics, especially governance mechanisms, including the popularity of financial accounting data in management contracts, the tendency to use accounting data to sign contracts with managers, the choice of accounting nature and governance structure, financial accounting information, and other corporate governance mechanisms. Additionally, information intermediaries can enhance the information quality of stock prices used to evaluate and compensate managers. For instance, financial analysts can examine publicly disclosed information, which helps to combine R&D information with stock prices (Kimbrough 2007), thus preventing managers from trading on private information.

Chen (2015) discusses the causal effect of analyst coverage on reducing agents' encroachment on external shareholders based on two origins of external shocks to analyst coverage (brokerage firm closure and merger). They find that with the exogenous decline of analyst coverage, the valuation of private cash holdings by shareholders decreases, with the CEO getting high compensation. Furthermore, the management conducts value-destroying acquisitions and also engages in earnings management activities. Importantly, they find that the impact is largely due to companies with lower level of initial analyst coverage and less competition on the product markets. Moreover, after external brokerage firms withdraw, CEOs' total compensation becomes less sensitive to the performance of companies with low initial analyst coverage. These conclusions are consistent with the assumption that financial analysts play an important governance role in reviewing management behavior.

Yu (2008) discusses the role of information intermediaries in corporate governance from the perspective of the impact of analyst coverage on earnings management. Using multiple methods of measurement of earnings management, he finds that high analyst coverage is correlated with less earnings management, while changes in analyst coverage are negatively correlated with changes in earnings management. Since the quality of financial reports also affects analyst coverage and reverse causation, the potential endogeneity of analyst reports is a major issue needed to solved in this research. To solve this problem, he uses two instrumental variables, based on changes in brokerage size and companies included in the S&P 500, and finds that the results are robust. He concludes that analyst reporting has a profound impact on those who make better forecasts, including those from top brokerage firms and more experienced ones.

Yu (2008) also highlights a reason for the decline in information asymmetry: the more analysts there are, the less earnings management there is. Analysts facilitate the dissemination of information and also affect enterprises' production of information. Yu (2008) also reveals ways to prevent speculative earnings management when conventional governance methods seem to be ineffective and counterproductive. Analysts must serve existing and potential stakeholders in the market. In addition, they have more sophisticated financial knowledge and resources than traditional gatekeepers to test earnings management. Therefore, he argues that analysts have unique characteristics that set them apart from other conventional internal regulators. The study results show that the role of information intermediaries in corporate governance is crucial. The hypothesis that an information intermediary acts as an external regulatory

agency is of great significance for the study of fraud detection, insider trading, executive compensation, and other corporate governance fields.

Another stream of literature evaluates the relationship between media and corporate innovation. In their seminal papers, Zingales (2000) and Dyck and Zingales (2002) explain how the media plays an essential regulatory role in influencing corporate policies and guiding company resource distribution decisions. For instance, the articles acknowledge the positive role of business media in the detection of accounting fraud (Miller 2006; Dyck, Morse, and Zingales 2010), reverse governance violations (Dyck, Volchkova, and Zingales 2008), expose board inefficiency (Joe, Louis, and Robinson 2009), monitor executive compensation (Kuhnen and Niessen 2012), restrict the application of dual-class shares (Braggion and Giannetti 2013), influence executives' capital allocation decisions (Liu and McConnell 2013), restrain insider trading (Dai, Parwada, and Zhang 2015), and increase the probability of involuntary resignation of CEOs (You, Zhang, and Zhang 2017).

Given that external investors can't invest all of the company's potential projects, managers tend to shift their investment decisions to lower-risk, resource-saving projects. In situations of severe moral hazard, managers can sacrifice the company's resources for private interests. Various studies demonstrate that media play a vital role in regulating managers to reduce agency costs. According to Liu and McConnell (2013), the media encourage managers to make appropriate investment decisions on the acquisition market. Therefore, considering that managers tend to choose less risky and more resource-saving projects, the media contributes to innovation investment through the external governance channel.

Generally, a transparent information environment helps managers choose important R&D projects and restrict their operation. As a result, resources are invested in projects which are predicted to primarily benefit shareholder rather than managers, thus preventing theft.

3. THE NEGATIVE EFFECT OF THE INFORMATION ENVIRONMENT ON INNOVATION

A transparent information environment can obstruct firms' innovation by putting excessive pressure on managers or by encouraging knowledge leakage to competitors.

3.1 Pressure Effect

The pressure effect is linked to the internal penalties that managers can face when they miss analysts' regular earnings forecasts. Failure to achieve the analysts' predictions is often punished by principals, causing agents to concentrate on programs that bring returns in the short term. Since most investments in innovation do not yield short-term gains, the agents followed by analysts may have an incentive to reduce innovation-related expenses.

As an influential market factor, the media may influence managers to give up long-term investment for short-term performance (Stein 1988). The US directors admit that they choose to ignore the company's long-term value when they are under pressure to meet or exceed profit targets, especially when there is a lack of commitment to long-term contracts for management compensation (Graham, Harvey, and Rajgopal 2005). Additionally, the media may publish interesting articles to cater to readers' interests. Given that coverage of a company's short-term results is often more compelling than its long-term growth, media sensationalism may focus on the short-term outcomes instead of long-term growth. The risk of prejudiced media reporting of revenue and other short-term performance indicators, therefore, worsens management short-termism and leads to a decline in long-term business investment.

Using a large sample of corporate news reports and patent activities over twelve years, Dai et al. (2018) study the impact of media reports on corporate innovation by analyzing two hypotheses: the spotlight-burning hypothesis and the spotlight-spurring hypothesis. They use a variety of identification strategies to alleviate significant concerns about the severe effect of media coverage on innovation. Their main result is consistent with the spotlight-burning hypothesis that media coverage exerts a negative effect on firm innovation. Therefore, they suggest a negative correlation between media coverage and corporate innovation. They also provide a mechanism to explain the impact: excessive pressure on managers.

Kraft (2017) makes use of the transition of American companies from an annual report through semi-annual reports to quarterly reports during the period from 1950 to 1970. The study provides evidence on the outcomes of increasing the reporting frequency for the companies' investment decisions. Estimates from difference-in-difference indicate that increased reporting frequency is associated with a considerable economic decline in investment. Furthermore, the reduction in investment is most consistent with short-sighted management behavior caused by frequent financial reporting.

From the perspective of analysts' coverage, He and Tian (2013) study the impact of financial analysts on the real economy in innovation cases. Their conclusion indicates that companies with more analysts generate fewer patents and have less impact. To establish causation, they used the difference-in-difference method, which relies on variations caused by multiple exogenous shocks to analyst coverage, and an instrumental variable approach. Their identification strategy shows the negative causal relationship between analyst coverage and corporate innovation. The outcomes indicate that analysts put too much pressure on managers to achieve short-term goals, preventing companies from investing in long-term innovation projects.

Several types of research examine the possible underlying mechanisms in an effort to explain the pressure effect of analyst coverage on corporate innovation. First, He and Tian (2013) consider whether different types of institutional ownership can help explain the pressure effect hypothesis. The difference between different types of institutional investors is that professional institutional investors will actively collect basic information of companies and concentrate their investment on several companies. By contrast, non-specialist institutional investors seek short-term profits rather than gathering information about a company's potential value, holding highly diversified portfolios and small stakes in many companies, so they have less access to private information. He and Tian (2013) expect the holdings of professional institutional investors to increase after the exogenous declines as reported by analysts because increased information asymmetry "crowds out" demand from non-specialist investors. They suggest that there is a negative relationship between analyst coverage and specialist institution investors. Meanwhile, the model of Aghion, Van Reenen, and Zingales (2013) illustrates that focused institutional investors are more likely to encourage corporate innovation than non-focused institutional

investors. As a result, the ownership of different types of institutional investors could be a potential economic mechanism through which analyst reporting discourages innovation.

A second underlying mechanism is the risk of the company being taken over. According to Yu (2008), companies with fewer analysts participate in more accrual earnings management, which reduces the quality of financial statements. Poor-quality accounting prevented external investors from accessing information and increases the adverse selection cost of potential bidders. Besides, Amel-Zadeh and Zhang (2010) show that companies with lower accounting quality are unlikely to be acquisition targets. Therefore, there is a positive relationship between analyst coverage and acquisition risk. Similarly, Stein (1988) argues that because shareholders fail to correctly evaluate managers' investment in long-term innovative projects, an active acquisition market induces managers to invest more in short-term projects, which provide faster returns than long-term innovative projects. Acquisition risk may be a potential mechanism that helps explain the pressure impact of analyst reporting on innovation.

Other mechanisms such as stock liquidity shortages and implementation of earnings management technology on the accrual basis are also mentioned in the study by He and Tian (2013). Through these mechanisms, analysts damage innovation, and He and Tian (2013) show that even if the control these mechanisms, analysts have residual effects on innovation still. Their paper provides new evidence of the adverse consequences of being understudied by analysts—it discourages corporate innovation.

3.2 Knowledge Leakage

A transparent information environment discourages corporate innovation by exposing proprietary information to competitors.

Innovation programs are generally considered difficult to finance in a competitive market. It is not challenging to find support for this assumption in the form of theoretical models, which mostly begin with the original works of Nelson (1959) and Arrow (1962), although Schumpeter hinted at it. The argument states that the main output of innovation investment is knowledge about creating novel products and services, which is not used competitively by one company, and doesn't impede the use by another organization. When knowledge does not remain confidential, the returns from investing in it cannot be taken up by the companies undertaking the investment, the firms are reluctant to invest, leading to insufficient preparation for innovation investment in the economy.

On this basis, existing economic literature provides evidence for the knowledge leakage of patent. For instance, Jaffe, Trajtenberg, and Henderson (1993) discover that the cost of 'stealing' a patent is determined by the geographical distance between two innovators and affects the possibility of technology spillovers. A study by Jaffe, Trajtenberg, and Fogarty (2000) shows that knowledge leakage can occur between innovators and competitors, among others. Bloom, Schankerman, and Van Reenen (2013) show that information leakage among competitors would hurt firm value. As information intermediaries, the media may draw attention to the existence of innovation and encourage competitors to obtain information in other ways. Researchers see this mechanism as a knowledge spillover channel. Through this channel, when companies are highly exposed to the media spotlight, managers may be prevented from innovating, because knowledge leakage, especially in highly competitive industries, may bring apparent benefits to highly competitive companies.

Bhattacharya and Ritter (1983), based on the model of corporate information disclosure, suggest that disclosure of proprietary information would damage the potential value of

innovation. While a company's accounting information may indirectly reveal technical information, it is a way for similar associations to obtain sensitive strategic information. These information leaks can enable equals to observe the innovation performance of companies better, change their innovation policies accordingly, and imitate innovation strategies.

To clarify the risk of knowledge leakage, Claessens and Laeven (2003) conduct an empirical study on the responsibility of property privileges in influencing the distribution of resources by using the cross-sectional changes in the protection of intellectual property rights at the national level, which are crucial to guard the return on innovation investment against the risk of leakage. They suggest that the allocation of available resources is the main channel through which property rights affect corporate growth. At the corporate level, their concept of property rights is different from that commonly seen in the literature, which generally regards property rights as protecting assets from government actions. Their philosophy of property rights is to protect returns on assets from powerful competitors. By focusing on the asset side of a company's balance sheet, they have switched to the term "equity" to protect entrepreneurship and other investments in the assets from the actions of other businesses. They argue that companies operating in markets with weak property rights, as opposed to intangible assets, may find problems and invest more in fixed assets.

Their arguments are as follows. Because of the actions of the government, the company's own employees, or other companies, companies are always at risk of not being rewarded for their assets (tangible or intangible). It is relatively easy for employees and other companies, especially powerful competitors, to steal intangible assets if the property rights are not secure. In a narrow sense, this is because many intangible assets – the value of patents, copyrights, and trademarks (unique business marks or symbols of property rights) – derive purely from the existence of property rights. Without title protection, employees can easily depart with many of the company's intangible assets, which competitors can easily replicate. Therefore, the narrow sense of property rights to ensure the benefits of intangible assets is very important. By contrast, it is more difficult to steal fixed investment, such as equipment, especially for competitors. Therefore, property rights are more important to ensure the return of intangible assets than tangible assets. The importance of property rights to intangible assets is greater than the importance of property rights to tangible assets.

4. FUTURE RESEARCH

In this section, I discuss several areas that can be studied in depth in the future regarding the relationship between the information environment and corporate innovation. In my view, one fruitful direction for future research is to explore the impact of exogenous events related to the information environment on corporate innovation, such as Google's withdrawal from the People's Republic of China (PRC) (Wang et al. 2018; Kong et al. 2019).

Some attempts have been made to understand the outcome of the sudden closure of the Google search service in the PRC. Wang et al. (2018) studied how information transmission efficiency affects enterprise transparency and how to shape investors' information set. Specifically, they used Google's withdrawal from the PRC as a controlled experiment to determine and evaluate the effectiveness of information dissemination, rather than production, in developing corporate disclosure strategies.

Kong et al. (2019) hold that information accessibility is the determinant of enterprise innovation. The abrupt termination of the Google Internet search service in the PRC will

have a huge and lasting negative impact on the intensity and quality of enterprise innovation activities. Google's withdrawal has hampered companies' ability to obtain information from overseas, and companies that rely more on foreign technology have experienced a greater decline in patent applications, citations, and the number of citations per patent. They find that the results are more pronounced in innovative industries, regions with local network filters, and regions with fewer alternative sources of foreign information. There is still a lot of room to study the ways and mechanisms through which exogenous events affect companies' innovation strategies and innovation outputs.

I also believe that there is a lack of research on how the information environment affects corporate innovation in other ways and exploration of different underlying mechanisms.

While many studies have linked transparency to higher levels of R&D and patent practices, these findings do not show the impact of transparency on the kinds of innovations that are happening. For example, Brown and Martinsson (2019) find that the location of innovation is driven by the shift from companies with high cash flow to those dependent on independent financing. They argue that transparency influences not only the level of innovation but also the nature of innovation activities (Atanassov 2016) and, more broadly, the extent of innovation-driven creative destruction (Aghion and Howitt 1992). Therefore, I believe an important theme of further work will be examination of the extent to which corporate transparency affects exploratory and high-risk innovation projects and assessment of the dynamic impact of such innovation on industry competition structure and long-term performance.

5. CONCLUSION

In recent years, financial and economic scholars are increasingly concerned about the impact of the information environment on corporate innovation. This survey reviews the core literature that has had a broad impact and the literature supporting the relevant arguments. I summarize the role of the information environment in innovation and illustrate the mechanisms under which these impacts happen: on one side, a transparent information environment can improve corporate innovation by reducing external financial constraints, motivating internal management incentives, improving project selection, and providing high-quality external and internal governance. On the other hand, it can hinder firm innovation by exerting excessive pressure on managers or by triggering knowledge leakage to industry competitors. Finally, I express views on several valued future research directions in this research theme from two perspectives.

REFERENCES

Aboody, D., and Lev, B. 2000. “Information asymmetry, R&D, and insider gains.” The Journal of Finance, 55(6), 2747–2766.

Aghion, P., and Howitt, P. 1990. “A model of growth through creative destruction (No. w3223).” National Bureau of Economic Research.

Aghion, P., Van Reenen, J., and Zingales, L. 2013. “Innovation and institutional ownership.” American economic review, 103(1), 277–304.

Amel-Zadeh, A., Zhang, Y., 2010. “The economic consequences of financial reporting quality for the market for corporate control: evidence from financial restatements.” Unpublished working paper.

Armstrong, C. S., Guay, W. R., and Weber, J. P. 2010. “The role of information and financial reporting in corporate governance and debt contracting.” Journal of Accounting and Economics, 50(2–3), 179–234.

Arrow, K. 1962. “Economic welfare and the allocation of resources for invention. The rate and direction of inventive activity: economic and social factors.” National Bureau of Economic Research.

Atanassov J., 2016. “Arm’s length financing and innovation: Evidence from publicly traded firms.” Management Science. 62(1), 128–155.

Bebchuk, L., Stole, L., 1993. “Do short-term objectives lead to under- or overinvestment in long-term projects?” Journal of Finance 48, 719–730.

Beyer, A., Cohen, D.A., Lys, T.Z., Walther, B.R., 2010. “The financial reporting environment: Review of the recent literature.” Journal of Accounting and Economics. 50, 296–343.

Bhattacharya, S., and Ritter, J. R. 1983. “Innovation and communication: Signalling with partial disclosure.” The Review of Economic Studies, 50(2), 331–346.

Blankespoor, E., Miller, G., White, H., 2014. “The role of dissemination in market liquidity: Evidence from firms’ use of Twitter.” The Accounting Review 89, 79–112.

Bloom, N., Schankerman, M., Van Reenen, J., 2013. “Identifying technology spillovers and product market rivalry.” Econometrica 81, 1347–1393.

Braggion, F., Giannetti, M., 2013. “On the determinants of the non-voting shares’ discount: Investor preferences and fundamentals.” Working paper, Tilburg University.

Brandenburger, A., Polak, B., 1996. “When managers cover their posteriors: Making the decisions the market wants to see.” RAND Journal of Economics, 1996, 523–541.

Brown J R, Martinsson G. “Does transparency stifle or facilitate innovation?” Management Science, 2018, 65(4): 1600–1623.

Brown, J.R., Martinsson, G., Petersen, B.C., 2013. “Law, stock markets, and innovation.” Journal of Finance 68, 1517–1549.

Bushee, B., Core, J., Guay, W., Hamm, S., 2010. “The role of the business press as an information intermediary.” Journal of Accounting Research 55, 1–19.

Bushman, R.M., Smith, A.J., 2001. “Financial accounting information and corporate governance.” Journal of Accounting Economics. 32, 237–333.

Bushman, R. M., and Smith, A. J. 2003. “Transparency, financial accounting information, and corporate governance. Financial Accounting Information, and Corporate Governance.” Economic Policy Review, 9(1).

Bushman, R., Williams, C., Wittenberg-Moerman, R., 2017. “The informational role of the media in private lending.” Journal of Accounting Research 48, 115–152.

Chang, X., McLean, D., Zhang, B., and Zhang, W., 2016. “Innovation and productivity growth: Evidence from global patent award.” Working paper, University of Cambridge.

Chen, Q., Goldstein, I., Jiang, W., 2007. “Price informativeness and investment sensitivity to stock price.” Review of Financial Studies. 20 (3), 619–650.

Chen T, Harford J, Lin C. “Do analysts matter for governance? Evidence from natural experiments.” Journal of Financial Economics, 2015, 115(2): 383–410.

Claessens S, Laeven L. “Financial development, property rights, and growth.” The Journal of Finance, 2003, 58(6): 2401–2436.

Dai, L., Parwada, J., Zhang, B., 2015. “The governance role of the media through news dissemination: Evidence from insider trading.” Journal of Accounting Research 53, 331–366.

Dai L, Shen R, Zhang B.,2018. “Does the media spotlight burn or spur innovation?” Available at SSRN 3037838.

Daske, H., Hail, L., Leuz, C., Verdi, R., 2013. “Adopting a label: Heterogeneity in the economic consequences around IAS/IFRS adoptions.” Journal of Accounting Research. 51, 495–547.

Dyck, A., Morse, A., Zingales, L., 2010. “Who blows the whistle on corporate frauds?” Journal of Finance 65, 2133–2255.

Dyck, A., Volchkova, N., Zingales, L., 2008. “The corporate governance role of the media: Evidence from Russia.” Journal of Finance 63, 1093–1135.

Dyck, A., Zingales, L., 2002. “The corporate governance role of the media.” Working paper, National Bureau of Economic Research, No. 9309.

Fang, L., Peress, J., 2009. “Media coverage and the cross-section of stock returns.” Journal of Finance 64, 2023–2052.

Graham, J., Harvey, C., Rajgopal, S., 2005. “The economic implications of corporate financial reporting.” Journal of Accounting and Economics 40, 3–73.

Greenspan, A. 2002. “Federal Reserve Board’s semiannual monetary policy report to the Congress: testimony before the Committee on Banking, Housing, and Urban Affairs,” US Senate, 16 July 2002 (No. 13).

Guo, B., Pérez-Castrillo, D., Toldrà-Simats, A., “Firms’ innovation strategy under the shadow of analyst coverage.” Journal of Financial Economics, 2019, 131(2): 456–483.

Hall, B. H. 2002. “The financing of research and development.” Oxford review of economic policy, 18(1), 35–51.

He, J. J., Tian, X., “The dark side of analyst coverage: The case of innovation.” Journal of Financial Economics, 2013, 109(3): 856–878.

Hemmer, T., Labro, E., 2008. “On the optimal relation between the properties of managerial and financial reporting systems.” Journal of Accounting Research. 46, 1209–1240.

Hirshleifer, D., Hsu, P.-H., Li, D., 2013. “Innovative efficiency and stock returns.” Journal of Financial Economics. 107, 632–654.

Holmstrom, B., 1989. “Agency costs and innovation.” Journal of Economic Behavior and Organization 12, 305–327.

Hope, O. K., and Thomas, W. B. 2008. “Managerial empire building and firm disclosure.” Journal of Accounting Research, 46(3), 591–626.

Jaffe, A., Trajtenberg, M., Fogarty, M., 2000. “Knowledge spillovers and patent citations: Evidence from a survey of inventors.” American Economic Review 90, 215–218.

Jaffe, A., Trajtenberg, M., Henderson, R., 1993. “Geographic localization of knowledge spillovers as evidenced by patent citations.” Quarterly Journal of Economics 108, 577–598.

Joe, J., Louis, H., Robinson, D., 2009. “Managers’ and investors’ responses to media exposure of board ineffectiveness.” Journal of Financial and Quantitative Analysis 44, 579–605.

Kong, D., Lin, C., Wei, L., and Zhang, J., 2018. “Information Accessibility and Corporate Innovation.” Available at SSRN 3291811.

Kraft, A. G., Vashishtha, R., Venkatachalam, M., “Frequent financial reporting and managerial myopia.” The Accounting Review, 2017, 93(2): 249–275.

Kuhnen, C., Niessen, A., 2012. “Public opinion and executive compensation.” Management Science 58, 1249–1272.

Leuz, C., Nanda, D., Wysocki, P.D., 2003. “Earnings management and investor protection: an international comparison.” Journal of Financial Economics. 69, 505–527.

Liu, B., McConnell, J., 2013. “The role of the media in corporate governance: Do the media influence managers’ capital allocation decisions?” Journal of Financial Economics 110, 1–17.

Loureiro, G., Taboada, A.G., 2015. “Do improvements in the information environment enhance insiders’ ability to learn from outsiders?” Journal of Accounting Research. 53, 863–905.

Kimbrough, M. D. 2007. “The influences of financial statement recognition and analyst coverage on the market’s valuation of R&D capital.” The accounting review, 82(5), 1195–1225.

Manso, G., 2011. “Motivating innovation.” Journal of Finance 66, 1823–1860.

McNichols, M.F., Stubben, S.R., 2008. “Does earnings management affect firms’ investment decisions?” Accounting Review. 83, 1571–1603.

Meade, L. M., and Presley, A. 2002. “R&D project selection using the analytic network process.” IEEE transactions on engineering management, 49(1), 59–66.

Milbourn, T., 2003. “CEO reputation and stock-based compensation.” Journal of Financial Economics 68, 233–262.

Miller, G., 2006. “The press as a watchdog for accounting fraud.” Journal of Accounting Research 44, 1001–1033.

Nelson, R. R. 1959. “The simple economics of basic scientific research.” Journal of Political Economy, 49, 297–306.

Porter, Michael. 1992. “Capital disadvantage: America’s failing capital investment system.” Harvard Business Review 70: 65–82.

Romer, Paul. 1986. “Increasing returns and long-run growth.” Journal of Political Economy 94:1002–1037.

Rosenberg, Nathan. 2004. “Innovation and economic growth.” OECD 1–6.

Stein, J.C., 2003. “Agency, information and corporate investment.” Handbook of the Economics of Finance 1, 111–165.

Solow, Robert. 1957. “Technical change and the aggregate production function.” Review of Economics and Statistics 39, 312–320.

Tetlock, P., Saar-Tsechansky, M., Macskassy, S., 2008. “More than words: Quantifying language to measure firms’ fundamentals.” Journal of Finance 63, 1437–1467.

Wang, K., Yu, X., and Zhang, B. 2018. “Panda Games: Corporate Disclosure in the Eclipse of Search.” Kelley School of Business Research Paper, (18-2).

You J, Zhang B, Zhang L. “Who captures the power of the pen?” The Review of Financial Studies, 2017, 31(1): 43–96.

Yu, F. F. 2008. “Analyst coverage and earnings management.” Journal of Financial Economics, 88(2), 245–271.

Zhong, R. I. 2018. “Transparency and firm innovation.” Journal of Accounting and Economics, 66(1), 67–93.

Zingales, L., 2000. “In search of new foundations.” Journal of Finance 55, 1623–1653.