Crowd Governance: The Monitoring Role of Wikipedia in the Financial Market

Weifang Wu
Dept. of ISOM
School of Business and Management
Hong Kong University of Science and Technology
wwu@ust.hk

Xiaoquan (Michael) Zhang
Dept. of ISOM
School of Business and Management
Hong Kong University of Science and Technology
zhang@ust.hk

Rong Zheng
Dept. of ISOM
School of Business and Management
Hong Kong University of Science and Technology
rzheng@ust.hk

Completed but Unpublished Research Paper

Nov 21, 2014

Crowd Governance: The Monitoring Role of Wikipedia in the Financial Market

Completed but Unpublished Research Paper

ABSTRACT

In this study, we explore whether Wikipedia plays a governance role in the financial market by reducing the information disadvantage of individual investors. We hypothesize that the aggregation of information on Wikipedia enables individual investors to collectively monitor insiders and institutional investors. Using the creation of a firm Wikipedia page as an information event, our empirical results support our hypothesis and further show that the governance effect is stronger for firms with higher institutional ownership concentration as well as those with more intensive insider trading activity. Taken together, these findings support the view that Wikipedia helps mitigate the information asymmetry among individual investors, institutional investors, and corporate insiders.

Key words: corporate governance, Wikipedia, financial market, information asymmetry, insider trading, institutional investors

Crowd Governance: The Monitoring Role of Wikipedia in the Financial Market

Completed but Unpublished Research Paper

1. Introduction

The emergence of big data has played an important role in making information available and accessible for market participants. In traditional product markets, big data such as search-engine-indexed webpages or user-generated online reviews allow buyers to collect product information (Ba and Pavlou 2002; Gu et al 2012). In the financial market, the ease and speed of Internet trading has attracted many individual investors and significantly changed how people participate in the market (Clemons and Weber 1996, 1997; Looney and Chatterjee 2002). However, questions remain on how individual investors embrace the opportunities of making valuable use of Internet-powered big data. More importantly, it is unclear how big data can help relatively uninformed investors become more informed and change the status quo of the market.

In the financial market, access to information varies greatly across types of participants. Insiders, such as major shareholders or top management, possess private information about a company and thus enjoy an investment advantage over outsiders. Institutional investors have closer ties to firm management and thus possess an advantage in their access to information compared to other outside investors. Individual investors, by contrast, possess no private information or access advantage and thus are in an inferior position (Grossman and Stiglitz 1980; Kyle 1984; Malkiel 1999). The resulting information asymmetry across investor types reduces market efficiency (Healy and Palepu 2001).

To address the issue of information asymmetry, government relies on a combination of corporate governance and regulatory mechanisms. For example, in 2000, U.S. Securities and Exchange Commission (SEC) enforced the Regulation Fair Disclosure (Reg FD) to prohibit "selective disclosure" by corporate managers. Similarly, in 2002, Sarbanes-Oxley (SOX) was enacted to improve the accuracy and reliability of corporate disclosures and clarify the penalties for fraudulent financial reporting by corporate managers. While such regulations improve individual investor protection (Bushee et al. 2004; Zhang 2007), individual investors remain at a disadvantage, according to Francis et al. (2006) and Jagolinzer et al. (2011). As a result, individual investors, who constitute a significant portion of the investor base, still bear higher information risk than do either insiders or institutional investors (e.g., Barber et al. 2009; Odean 1999).

In an effort to increase their access to information, individual investors have turned to the Internet, which has become a powerful platform for small investors to combat the information disadvantage collectively. Such actions have made a difference in the overall market. For example, Antweiler and Frank (2004) find that the sentiment of Yahoo! discussion board messages helps predict market volatility even after controlling for financial news. More recently, investors have utilized social media platforms such as Wikipedia and Twitter to effectively supply and consume information. With 500 million unique monthly visitors and 130,000 active contributors, Wikipedia provides a strong venue for information aggregation. Wikipedia data is considered big data because of its large volume, fast growth velocity and variety of information, including text, hyperlinks, editing logs and contributor information. As of February 2014, Wikipedia was the sixth most-popular website worldwide, receiving 18

billion page views every month.

While Wikipedia is a knowledge repository on the Internet, its design also makes it especially rich as a source of company information when compared to traditional news sources. First, Wikipedia provides a virtual memory of all historical information in a concentrated and integrated form (Kankanhalli et al. 2005; Stein and Zwass 1995). Consequently, it provides rich contextual information related to company news. Second, unlike traditional media, where the information is centrally generated and cascaded to the crowd, Wikipedia aggregates information from the crowd. Therefore, the information processed by Wikipedia has the merits of "wisdom of the crowd" (Surowiecki 2004). That is, the information on Wikipedia is likely to be more comprehensive, unbiased and timely. Third, Wikipedia pages are highly accessible and in fact are often some of the highest ranked search engine results. Google even allocates a dedicated area on the results page that shows a synopsis of a company's information extracted from Wikipedia. Indeed, the *Financial Times* recognizes the role Wikipedia plays for investors: "the capital market is looking for information from companies in various social media channels and at a greater extent than we anticipated….Wikipedia is the most popular social media site for individuals looking for such information, used by more than three quarters of respondents."

Given its rich content and extensive use, Wikipedia has the potential to bring fundamental changes to the existing information environment of the financial market. For example, Wikipedia has been shown to regulate managers' voluntary disclosure behavior and shorten the release time for unfavorable news (Xu and Zhang, 2013). In this paper, we extend our understanding of the influence of Wikipedia on the financial market by studying whether

the availability of firm information on Wikipedia influences corporate management and large investors' decisions.

More specifically, we hypothesize that Wikipedia can serve a monitoring function by helping individual investors collectively monitor insiders and institutional investors through a "crowd governance" role. We illustrate this hypothesized effect in Figure 1. Here, the dotted lines represent the traditional mechanisms of governance while the solid lines represent crowd governance. We conjecture that Wikipedia can complement SEC rules in monitoring and regulating both managers and institutional investors.

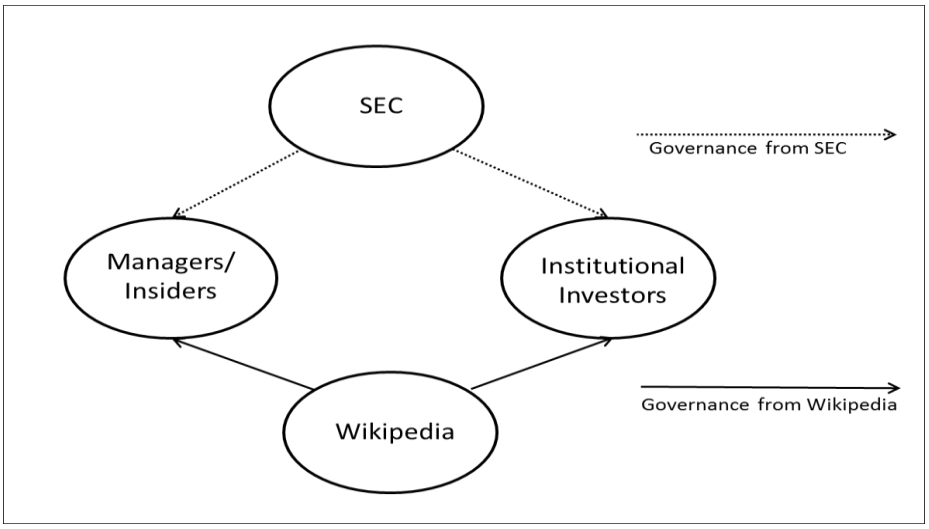

Figure1. Framework of Crowd Governance

While the crowd governance effect of Wikipedia makes sense intuitively, it is challenging to test empirically, as we cannot observe how individual investors use the information they obtain from Wikipedia. Even if we could establish a correlation between firm content modifications on Wikipedia and investor behavior, we still cannot rule out the possibility of other channels influencing both activities. To tackle this notorious identification problem, we adopt a well-established methodology in the finance literature. Specifically, we consider the creation of a firm's Wikipedia page as an information event and use an event

study approach to gauge the governance effect of Wikipedia on investors' behavior. The event study approach has been widely used not only in Finance and Accounting, but also in IS research (e.g., Brown and Warner 1985; Dos Santos et al. 1993).

Using an event study approach and the efficient market hypothesis, by which the market price fully reflects all publicly available information (Fama 1970), we measure the information content of the creation of a firm's Wikipedia page by examining the stock market's reaction to this event. This approach is similar to that of prior studies that estimate the impact of SOX and other regulations on the stock market (e.g., Ke et al. 2008; Zhang 2007). Our hypothesis is based on the notion that the market will react negatively to the creation of a firm Wikipedia page as Wikipedia would reduce the information advantage of insiders and institutional investors, who are effectively market movers. We validate our findings by examining the cross-sectional variance of the market reaction to the creation of a firm Wikipedia page depending on the proportion of insider trades or the concentration of institutional ownership within the firm.

2. Theoretical Background

2.1. Information Asymmetry in the Financial Market

The literature in finance has documented that different participants in stock market have different sets of information for making investment decisions (Ali et al. 2004; Utama and Cready 1997). Corporate insiders, defined broadly to include those that "have access to non-public, material, insider information", are the most informed party with respect to the firm's operations, risks, and opportunities. Literature suggests that insiders possess superior information and hence earn abnormal returns on their trades (e.g., Ke et al. 2003; Seyhun 1986, 1992). Institutional investors, by definition, are entities such as bank trust, insurance

companies, mutual funds, and pension funds that invest on the behalf of others.[1] Prior research suggests that institutional investors have superior access to information from companies (Ali et al. 2004). Individual investors, compared with corporate insiders and institutional investors, have fewer resources and inferior skills to access and process information. Prior studies show that the average individual investor underperforms the market, both before and after transaction costs (e.g., Barber et al. 2009; Odean 1999).

The information asymmetry can potentially lead to market inefficiency or even a breakdown in the functioning of the capital market (Healy and Palepu 2001). For example, it undermines the optimal allocation of capital to investment opportunities. It can also reduce market liquidity because uninformed investors might "price protect" against adverse selection (Healy and Palepu 2001). In addition, investors with an informational advantage can profit at the expense of others, and this practice will undermine investor confidence in the integrity of the capital markets (Chiyachantana et al. 2004).

In recognition of the information advantages of insiders and institutional investors, mechanisms of corporate governance and investor regulation are designed and enforced to mitigate the information asymmetry problem. We next review the literature about the impacts of corporate governance and investor regulation on financial market respectively. We then focus on social media studies (Wikipedia especially) related to the financial market.

2.2. Insiders and Corporate Governance

In modern firms, the separation of ownership and control creates the agency problem (Fama and Jensen1983a, b). A vast body of literature explains how managers or insiders use their effective control rights to pursue benefits of themselves rather than those of owners or investors (e.g., Jensen 1986; La Porta et al. 1998).

Corporate governance, as referring to "a set of mechanisms through which outside

[1] SEC Rule 13-F: http://www.sec.gov/answers/form13f.htm

investors protect themselves against expropriation by the insiders", deals with the agency problem (La Porta et al. 2000). The mechanisms of corporate governance fall into two general categories: internal monitoring system and external monitoring system (Iskander and Chamlou 2000). Internal monitoring system mainly refers to board of directors. External monitoring system includes the external auditor, the large outside investor and creditor, laws and regulations, and etc. Recent empirical studies show that corporate governance curtails insider trading profits. Ravina and Sapienza (2010) shows that profits on insider trades are larger at firms with weak governance standards. Jagolinzer et al. (2011) shows firm's internal control process can also mitigate informed insider trading.

As the central regulator of the financial market, SEC plays an important role in corporate governance by enforcing security laws. In 2002, SEC enforces the SOX, with a purpose to enhance corporate governance, financial reporting, and audit functions. The general understanding is that it provides benefits such as the improvement in the accuracy and reliability of accounting information that is reported to investors, but at the same time it proposes implementation costs that cannot be ignored by firms, especially for small firms (e.g., Chhaochharia and Grinstein 2007; Zhang 2007).

2.3. Institutional Investor Regulation

In publicly traded firms, large block holders (investors that hold at least 5 percent of equity ownership within the firm) are normally institutional investors. Literature suggests that ownership concentration, which refers to the amount of stock owned by large block shareholders, have two competing effects and the overall effect depends on which effect dominates (Barclay and Holderness 1992; Bhojraj and Sengupta 2003).

One effect is called "shared benefits", which suggests that a higher level of ownership concentration leads to more efficient corporate governance and that the benefits from such monitoring are shared by all stockholders (e.g., La Porta et al. 1998; Shleifer and Vishny

1986). Because the large block owners have strong incentives to proactively safeguard their investment, and it is much easier for them to take aggressive actions and effectively influence firm decisions such as the election of board members and replacement of CEO or poor management with their voting power (e.g., Cremers and Nair 2005).

A conflicting effect is "private benefits", which means that concentrated ownership allows the large block holders to exercise undue influence over the management to secure benefits that are to the detriment of other investors. Large block holders represent their own interests, which need not necessarily coincide with the interests of other investors of the firm (Shleifer and Vishny 1997). Barclay and Holderness (1989, 1992) find that large blocks of equity trades at a substantial premium to the posttrade price of minority shares, indicating that the buyers of the blocks that may have a controlling influence receive special benefits.

With regard to the "private benefits" effect, the SEC implemented Reg FD in August 2000 to weaken the information advantage of large institutional investors. The rule mandates that all publicly traded companies must disclose material information to all investors at the same time. Thousands of individual investors voiced their support for the regulation, while large institutional investors, those who benefit from selective disclosure, fought vigorously against the proposed regulation.[2] The empirical results in related studies mainly support the positive impact of Reg FD, such as the improved informational efficiency of stock prices and the decreased level of information asymmetry (Chiyachantana et al. 2004; Heflin et al. 2003).

However, there is anecdotal evidence that Reg FD have not completely eliminated institutional investors' access to nonpublic information from managers. Based on a survey in 2001 by Rivel Research (NIRI 2001)[3], 79% of the 577 National Investors Relations Institute member companies claim that they continue to hold one-on-one meetings with institutional investors to the same or greater extent than prior to Reg FD. Another survey shows that the

[2] http://en.wikipedia.org/wiki/Regulation_Fair_Disclosure

[3] National Investor Relations Institute (NIRI). "Survey Results on the Impact of SEC Regulation Fair Disclosure." Vienna, VA: NIRI, 2001.

research payments made by the biggest institutional investors to brokerage houses as compensation for "direct access to companies' management", is up from 10% after Reg FD.[4] Thus, despite the disclosure restrictions of Reg FD, institutional investors still seek opportunities of gleaning advanced information (Francis et al. 2006; Ke et al. 2008).

2.4. The Role of Social Media in the Financial Market

While the question of how to reduce information asymmetry has been of concern for a number of years, the role of social media in providing access to financial information has received only recent attention. Of those studies examining the role of information sites, a number have found that Wikipedia has substantially changed the overall information environment of the financial market by serving as a more efficient information intermediary than traditional news sources. For example, Moat et al. (2013) find that the returns obtained from a special trading strategy based on Wikipedia view logs of financial articles are significantly higher than those obtained through random trading strategies. In another study, Rubin and Rubin (2010) find that firms whose information is processed by the population more frequently (as measured by Wikipedia editing frequency) are associated with lower analyst forecast errors, smaller analyst forecast dispersion, and significant changes in bid-ask spreads on analyst recommendation days. Finally, Xu and Zhang (2013) find that information aggregation on Wikipedia impacts the supply side by moderating the timing of managers' voluntary disclosures of earnings disappointments and the demand side by moderating investors' negative reactions to bad news.

In addition to examining the impact of Wikipedia on financial markets, studies have

[4] Zuckerman, G., and E. Portanger. "One-on-Ones: Investor Meetings With Executives Surge, Add a Risk of Data Leaks - Brokers Are Avid Matchmakers for Talks That Can Veer Close to Disclosure Limits - How to Please Money Managers." Wall Street Journal (August 31, 2004): A1.

explored the influence of other social media platforms such as Twitter, online review platforms, and blogs. Of these studies, Bollen et al. (2011) are the first to relate Twitter content to stock market moves. In their study, they use measures of public mood across six dimensions (calm, alert, sure, vital, kind, and happy) to analyze daily tweets. Their results indicate that the predictive accuracy of the Dow Jones Industrial Average can be significantly improved by including specific public mood dimensions. In another study, Chen et al. (2013) find that the views expressed in both articles and commentaries on Seeking Alpha can predict future stock returns and earnings surprises. Similarly, Tirunillai and Tellis (2012) find that the volume of online review leads to abnormal returns by a few days, and that the effect of negative and positive reviews on abnormal returns is asymmetric and significant. Likewise, Luo et al. (2013) find that social media related metrics are significant leading indicators of firm equity value, stronger even than conventional online behavioral metrics such as Google searches and Web traffic, and that social media have a faster predictive power than conventional online media. Finally, Blankespoor et al. (2014) find that dissemination of firm-initiated news via Twitter is associated with lower abnormal bid-ask spreads and greater abnormal depths, consistent with a reduction in information asymmetry. Moreover, they find this result holds mainly for firms that are not highly visible, consistent with them being in greater need of this additional dissemination channel.

In sum, a number of studies have examined the impact of social media on the information environment of the financial market. However, none of these studies examines the role of social media as a governance mechanism. Our paper thus extends this line of research by investigating the governance effect of Wikipedia. Specifically, we argue that the

information aggregation on Wikipedia can protect individual investors by providing them with access to timely and relevant information.

3. Hypotheses

3.1. Wikipedia as a Crowd Governance Mechanism

From the perspective of this study, Wikipedia is an information intermediary that aggregates information from distributed sources such as company disclosures, news, analysts' research and individuals' private information. Indeed, Moat et al. (2013) find that the frequency of visits to Wikipedia pages related to financial topics is correlated with stock market moves. In a similar study, information processing via Wikipedia is positively related to the degree to which investors and analysts are informed about companies (Rubin & Rubin 2010). This result is consistent with the finding by Xu and Zhang (2013) that information aggregation on Wikipedia can moderate the timing of managers' voluntary disclosure of companies' earnings disappointments.

In our study, we argue that Wikipedia may serve a governance function by weakening the information advantage of corporate insiders and large institutional investors. It does so in several ways. First, Wikipedia aggregates a comprehensive array of detailed firm information from multiple channels. There are several thousand articles about traded companies on Wikipedia. For each company, Wikipedia keeps a comprehensive record of their histories, including significant news and recent developments. On Wikipedia, visitors can obtain aggregated information about a firm's products, management structure, operations, marketing, and sales as well as new product launches, store openings, and management changes. To illustrate the quality of information available on Wikipedia, consider its page for Baidu, the

leading Chinese search engine. On August 22, 2013, the page was modified to indicate that Baidu had launched a personal assistant app for business people to maintain business relationships. This event was reported by only China Internet Watch, a marketing blog produced in Singapore, but it was picked up by Wikipedia nonetheless. With its comprehensive recording of facts, Wikipedia reduces information asymmetry between informed and uninformed parties.

Second, Wikipedia provides its aggregated information in a timely manner. Wikipedia entries are edited multiple times a day, more frequently than analyst reports or traditional media sources. For example, the Wikipedia entries for Microsoft and Google receive an average of 806.1 and 1057.6 edits per year, respectively, or the equivalent of at least two edits a day.[5] When Google announced its acquisition of Motorola Mobility on August 15, 2011, almost immediately after the announcement, its Wikipedia entry was modified to include the new information.[6]

Third, Wikipedia is highly visible and widely distributed. It is the sixth most popular website in the world and the Internet's largest and most popular general reference website.[7] Furthermore, Wikipedia has substantial impact on active information seekers. Wikipedia pages for listed companies are often ranked among the highest in search results. For example, Wikipedia page of Dell is ranked first in the search for "Dell". According to Alexa, more than 50% of visits to Wikipedia are directed there by the results from a search engine inquiry. Da et al (2011) point out that search volume captures investor attention in a more timely fashion

[5] http://tools.wmflabs.org/xtools/articleinfo/index.php?article=Microsoft&lang=en&wiki=wikipedia, and http://tools.wmflabs.org/xtools/articleinfo/index.php?article=Google&lang=en&wiki=wikipedia
[6] http://en.wikipedia.org/w/index.php?title=Google&action=history&year=2011&month=8&tagfilter=
[7] http://en.wikipedia.org/wiki/Wikipedia

than traditional media. As such, when individual investors conduct research online, Wikipedia entries of listed companies are highly accessible.

Lastly, the rules of Wikipedia incentivize the provision of information that is objective and neutral, making it a credible information source for investors. Wikipedia has a reputation for being "a neutral compilation of verifiable, established facts".[8] In 2005, the journal *Nature* reported that Wikipedia is about as good a source of information as Britannica, the venerable encyclopedia.[9] Wikipedia achieves this level of quality through a comprehensive set of over 150 policies and guidelines concerning the type of content that is allowable and the type of user behavior that is acceptable.[10] For example, it requires entries to be written in a non-subjective manner. It also emphasizes information accuracy and the presentation of a balanced range of opinions, thus precluding managers or insiders from manipulating its content regarding their firms. Wikipedia also requires contributors to be wholly independent of the subjects of their articles. Moreover, the crowd wisdom nature of Wikipedia is a powerful self-regulator, as inaccurate or biased information is easily screened out by others. For the above reasons, Wikipedia is a distinct information intermediary that can potentially empower individual investors who do not otherwise have access to professional-level information sources.

To understand how Wikipedia can serve a corporate governance role, we consider previous studies on the role of the media on corporate governance. For example, Dyck et al. (2008) find that an increase in media coverage can increase the probability that a corporate governance violation will be reversed. While Wikipedia shares some traits with traditional

[8] Wikipedia in brief: http://en.wikipedia.org/wiki/Wikipedia:Wikipedia_in_brief
[9] http://www.nature.com/nature/journal/v438/n7070/full/438900a.html .
[10] About Contributing to Wikipedia: http://en.wikipedia.org/wiki/Wikipedia:About#Contributing_to_Wikipedia

media, it is different in that it offers a convenient, low cost method for obtaining high quality, timely information about firms. In doing so, it provides individual investors a way to overcome the rational ignorance problem, which means that when cost of becoming informed exceeds the benefit, individual investors choose not to be informed (Downs 1957). By extension, we hypothesize that Wikipedia reduces the information asymmetry across investor types and therefore functions as a governance mechanism in the financial market.

In testing this hypothesis, we encounter several potential challenges. One challenge is in how to assess the amount of new information an individual investor obtains through Wikipedia. Another challenge is how to separate the reactions of insiders or institutional investors to the acquisition of information by individual investors. To address these challenges, we adopt an event study approach and examine the reaction of relatively informed traders (institutional investors and insiders) to previously uninformed traders (individual investors). Accordingly, we hypothesize that insiders and large institutional investors who have information advantage will respond negatively to the creation of a firm-specific Wikipedia page. Because institutional investors possess dominant shares of a firm's stock,[11] we expect that the total market abnormal returns will be negative when a Wikipedia is created for a focal firm. This leads to our first hypothesis:

H1. A firm's informed investors will react negatively to the creation of the firm's Wikipedia page.

3.2. Crowd Governance and Informed Insider Trades

The intensity and profitability of insider trades are related to the degree of information

[11] Institutional ownership of common stock has increased substantially over the past 50 years, from 7% of US equities in 1950 to 51% in 2004 (Chen et al. 2007). In our sample, the mean of institutional ownership is about 70%.

asymmetry between managers and outside investors. Informed insider trades are driven by insiders' superior information about the prospects of their firm (e.g., Seyhun 1986, 1992). Insiders make a profit when they trade on value-relevant information before public disclosure leads to its full incorporation into stock prices.

As a crowd governance mechanism, Wikipedia entries of listed companies can mitigate the information asymmetry between insider and outsider investors. Frankel and Li (2004) use analyst following to show that information collection by outsiders reduce information asymmetry and limit insiders' ability to trade profitably on private information. Prior studies also show that corporate governance regulations restrict insider trades (Jagolinzer et al. 2011; Ravina and Sapienza 2010). Thus we expect that information aggregation on Wikipedia will limit informed insider trades. As such, when Wikipedia list a firm, insiders will react negatively. This negative reaction will be more significant for firms with more informed insider trades. This leads to our second hypothesis:

H2. Investor reaction to the creation of a firm Wikipedia page will be stronger for firms with a greater proportion of insider trades.

3.3. Crowd Governance and Concentrated Institutional Ownership

The concentration of institutional investors reflects the degree of information asymmetry between institutional investors and other investors. Institutions with large ownership positions often have more information because they have some exclusive access to board members and senior managers (Carleton et al. 1998). Management is likely to voluntarily disclose important information about future plans to large institutional investors to gain their confidence (El-Gazzar 1998). Firms also have incentives to reveal the bad news to large institutional investors to maintain their reputation and relationships with the institutional investors (Li et al. 2011).

As we mentioned earlier, there are two competing effects of concentrated institutional ownership. The correlation between concentrated institutional ownership and Wikipedia would depend on the evaluation of which effect is dominant. The "shared benefits" effect suggests that large institutional shareholders will support Wikipedia because it is aligned with their monitoring role. On the other hand, the "private benefits" suggests that large institutional shareholders do not like Wikipedia, because it will weaken their information advantage and play a monitoring role on their trading behavior.

In this paper, we expect that the "private benefits" will dominate, because the effect of Wikipedia is more directly related to the private benefits of large institutional shareholders. Similar to Reg FD, Wikipedia entries of listed companies will weaken the information advantage of large institutional investors. Thus we expect that Wikipedia will result in similar results, such as the decreased level of information asymmetry and the changes in institutional investors' portfolio allocation and trading strategy (e.g., Ke et al. 2008; Li et al. 2011).

Taken together, we predict that as a firm is first listed on Wikipedia, large institutional investors will react negatively. This negative reaction will be more significant for firms with higher institutional ownership concentration. This leads to our third hypothesis:

H3. Investor reaction to the creation of a firm Wikipedia page will be stronger for firms with a higher concentration of institutional ownership.

4. Empirical Methodology

To measure investors' reaction to a firm's Wikipedia page creation, we use an event study to compute the abnormal market returns on the creation day. Event study has been extensively used in Finance, Accounting and IS research (e.g., Dewan and Ren 2007; Dos Santos et al. 1993; Im et al. 2001). The usefulness of event study comes from the fact that, given a corporate context and market rationality, the effects of an event will be reflected immediately in security prices. Thus the economic impact of an event can be measured by the magnitude

of abnormal performance of security prices, observed over a relatively short time period around the event. The event in this paper is the listing of a company on Wikipedia.

We collect data from several sources: (1) editing history from Wikipedia, (2) firm data from Compustat, RiskMetrics IRRC database, (3) stock market data from Center for Research in Security Prices (CRSP), (4) Institutional ownership data and insider stock transaction data from Thomson Routers (5) EPS announcement data from I/B/E/S and (6) news-coverage data from Lexis-Nexis.

4.1. Sample Selection and Cleaning Procedure

We restrict our sample to Standard & Poor's 500 (S&P 500) firms. We compile the event dates (the creation date of a firm's Wikipedia page) through three steps. First, we obtain a list of S&P 500 firms at the end of 2012. Second, we retrieve the URLs of firms' Wikipedia pages at Google, and manually check the Google search results to ensure that the Wikipedia page is about the focal firm. Third, we obtain the creation date of firms' Wikipedia page, as well as other related information such as the contributors' information. We end up having 413 Wikipedia creation events in total for the S&P500 firms.

To control for the confounding effects on stock-price changes, we follow the common approach in IS literature to exclude those events that may be contaminated by other unrelated events or news such as dividends, earnings or other types of announcements (e.g., Dewan and Ren 2007; Dos Santos et al. 1993; Im et al. 2001). First, we exclude observations that have EPS announcements within a 2-week time window surrounding the event dates, because EPS announcements have a significant and a relative longer impact on the stock price. Second, we collect firm news from Lexis-Nexis and exclude observations that have news within a 3-day time window. We end up having 155 Wikipedia creation events after the cleaning steps.

We next obtain firm data and stock market data from Compustat, IRRC and CRSP, and institutional investors and insider transaction data from Thomson Routers. For institutional

ownership data, following Robert & Yuan (2010), we delete those firms with reported institutional ownership greater than 100% as reflecting data error. All the data of firm fundamentals, market characteristics, insiders, and institutional investors are from the year/quarter/month before the event date. After all these steps and excluding those observations that have missing values, we have 139 observations of the Wikipedia page creation events as our final sample. Table 1 summarizes the sample generation procedure.

Table 1. Sample Selection and Elimination Process

	Number of Observations
Events found through Google Search with manual check.	413
Deduct events that have EPS announcements within a 2-week time window around the events (to eliminate confounding events).	329
Deduct events that have news within (-1, 1) days window around the events (to eliminate confounding events).	155
Deduct events that have institutional ownership >100% or have missing values.	139

4.2.Variable Definitions

ABNORMAL RETURNS

We use the market model to calculate the abnormal returns following IS literature. First we need to calculate normal returns. We use 221 days, which starts from 252 days before the creation date (day 0) and ends 31 days before that date, as the estimation period.[12] We then use the estimation results to calculate the normal return of the event periods. The deviations of the realized returns from normal returns are estimates of abnormal returns.

INFORMED INSIDER TRADES MEASURES

Thomson-Reuters Insider Filing Data captures all U.S. insider activities. We follow the common approaches in literature to select the informed insider trades. We only include open

[12] The most common choice for the estimation window is using the period prior to the event window, and the event period itself is not included to prevent the event from influencing the parameter estimates. In addition, the estimation window needs to be large enough to mitigate the influence of sampling error to the variance of the abnormal return (MacKinlay 1997). Following previous studies, we chose 221 days to make the estimation window large enough. We also tried other estimation window such as 200 days and 250 days, and the results remain qualitatively the same.

market purchases and sales (Cohen et al. 2012; Ke et al. 2003), transactions with more than 100 shares (Lakonishok and Lee 2001; Scott and Xu 2004), and management insider purchases (Lakonishok and Lee 2001). We use two measures of aggregated informed insider trades: insider purchase and the net purchase ratio (NPR) (Ke et al. 2003; Scott and Xu 2004). NPR is the difference between insider purchases and insider sales divided by the sum of them. We use three forms for each measure: number of trades, number of shares, and total million dollars. In total, we have six variables for insider trades. The main analysis use the insider trades data in the prior calendar month of the Wikipedia creation event.

INSTITUTIONAL OWNERSHIP CONCENTRATION MEASURES

Thomson-Reuters Institutional Holdings (13F) Database provides institutional common stock holdings and transactions. Following prior research, we use Herfindahl index, top 5 institutional ownership, and block institutional ownership to measure institutional ownership concentration (e.g., Bushee and Goodman 2007; Hartzell and Starks 2003; Roberts and Yuan 2010). In addition, we add max institutional ownership and top 10 institutional ownership. We also include institutional ownership as a comparison. The main analysis uses the institutional ownership data in the prior fiscal quarter of the Wikipedia creation event.

CONTROL VARIABLES

First, we construct five measures to control the characteristics of the Wikipedia creation event. We measure information richness, *1stWikiWords*, as the log of the number of words in the firm's first Wikipedia page. *1stWikiTone* measures sentiment and is calculated as the number of positive words minus number of negative words, scaled by the total number of words in the firm's first Wikipedia page.[13] We construct two measures of information credibility: *WikiUserPageBef*, as the log of the number of other SP500 firms' pages created before the event period by the user who creates the firm's first Wikipedia page; *isIP*, as a

[13] We use the positive word list and negative word list from Diction of Linguistic Inquiry and Word Count (LIWC) for text analysis, which is designed by James W. Pennebaker, Roger J. Booth, and Martha E. Francis. Using other wordlists gave qualitatively the same results.

dummy variable where 1 indicates that the firm's first Wikipedia page is created by an IP address, rather than a regular Wikipedia user. *1stDayWikiUserRev* measures attention, as the log of the number of users create/revise a particular firm's Wikipedia page on the event day.

Second, we control for a set of variables following the firm valuation models in literature. We control for firm size (Xu and Zhang 2013; Luo et al. 2013), *MktCap*, measured as the log of market value of firm's equity. We control for firm's growth opportunities using the book-to-market assets ratio, *BTM* (Blankspoor et al. 2014, Chen et al. 2013). We also control for advertising expense, *XAD*, which is an indirect proxy for investor attention (Da 2011). We use the Governance Index, *GIndex*, to gauge the strength of shareholder rights (Gompers et al. 2003). We also control for the one-digit SIC industry dummies (Tambe and Hitt 2012), the year dummies (Ranganathan and Brown 2006), and the weekday dummies. All the variables are described in Table 2.

Table 2. Definitions of Variables

Variable	Description
Abnormal Return (calculated using CRSP data)	
AR	Abnormal return on event day (day 0), calculated using market model and CRSP equally-weighted market index.
Insider Trades (calculated using data from Thomson Reuters Insider Filings)	
InsiderPnum	Insider purchase number, which is the log of total number of insider purchase trades.
InsiderNPRnum	Insider net purchase ratio based on trade number, which is the number of insider purchases minus the number of insider sales, scaled by the total number of insider transactions.
InsiderPshare	Insider purchase shares, which is the log of total shares of insider purchases.
InsiderNPRshare	Insider net purchase ratio based on trading volume, which is total shares of insider purchases minus total shares of insider sales, scaled by the total shares of insider transactions.
InsiderPmdollar	Insider purchase million dollar, which is the log of the million dollar value of insider purchases.
InsiderNPRmdollar	Insider net purchase ratio based on trading value, which is the million dollar value of insider purchases minus the million dollar value of insider sales, scaled by the total million dollar value of insider transactions.
Institutional Ownership (calculated using data from Thomson Reuters 13f)	
InstownHHI	Institutional ownership Herfindahl-Hirschman Index, which is the sum of squared institutional share percentage.

MaxInstOwn	Max institutional ownership, which is the percentage of shares outstanding held by the firm's largest institution.
Top5InsOwn	Top 5 institutional ownership, which is the percentage of shares outstanding held by a firm's top 5 institutional investors.
Top10InstOwn	Top 10 institutional ownership, which is the percentage of shares outstanding held by a firm's top 10 institutional investors.
InstBlockOwn	Institutional block holding, which is the percentage of shares outstanding held by a firm's institutional investors whose holdings are greater than 5%.
InstOwn	Institutional ownership, which is the percentage of shares outstanding held by institutional investors.
Control Variables (calculated using data from Wikipedia, Compustat, CRSP, and IRRC)	
1stWikiWords	Log of the number of words in a firm's 1st Wikipedia page.
1stWikiTone	(Number of Positive words–Number of Negative words) / Total number of words in a firm's 1st Wikipedia page.
1stDayWikiUserRev	Log of the number of users create/revise the firm's 1st Wikipedia page on day (0).
WikiUserPageBef	Log of the number of other SP500 firms' pages created before day (0) by the user who creates the firm' 1st Wikipedia page.
isIP	Dummy variable. 1 indicates that the firm's 1st Wikipedia page is created by an IP address, not a regular Wikipedia user; 0 indicates the opposite.
MktCap	Log of market value of firm's equity on the quarter end date before the event.
BTM	Book-to-market assets ratio on the quarter end date before the event.
XAD	Advertising expenditure in the year before the event.
Gindex	Governance index, determines how many corporate governance provisions exist that restrict shareholder rights.

5. Empirical Results

5.1. Summary Statistics

Table 3. Descriptive Statistics and Correlation Matrix of Key Variables

	mean	S.D.	[1]	[2]	[3]	[4]	[5]	[6]
[1]AR	-0.003	0.016	1					
[2]InsiderPnum	0.108	0.296	-0.074	1				
[3]InsiderNPRnum	-0.316	0.600	-0.073	0.419***	1			
[4]InsiderPshare	1.016	2.694	-0.116	0.939***	0.444***	1		
[5]InsiderNPRshare	-0.340	0.602	-0.064	0.308***	0.976***	0.345***	1	
[6]InsiderPmdollar	0.014	0.051	-0.124	0.660***	0.262**	0.813***	0.211*	1
[7]InsiderNPRmdollar	-0.340	0.602	-0.064	0.306***	0.975***	0.343***	1.000***	0.207*
[8]InstownHHI	0.043	0.026	-0.139	0.126	0.142	0.145	0.106	0.163
[9]MaxInstOwn	0.090	0.055	-0.128	0.082	0.051	0.087	0.024	0.127
[10]Top5InsOwn	0.250	0.094	-0.112	-0.014	0.010	-0.003	0.006	0.017
[11]Top10InstOwn	0.354	0.109	-0.086	-0.053	-0.023	-0.046	-0.016	-0.024
[12]InstBlockOwn	0.136	0.123	-0.077	-0.023	0.025	0.004	0.024	0.030
[13]InstOwn	0.703	0.148	-0.012	-0.096	-0.150	-0.126	-0.133	-0.114

(continued)

	[7]	[8]	[9]	[10]	[11]	[12]	[13]
[1]AR							
[2]InsiderPnum							
[3]InsiderNPRnum							
[4]InsiderPshare							
[5]InsiderNPRshare							
[6]InsiderPmdollar							
[7]InsiderNPRmdollar	1						
[8]InstownHHI	0.107	1					
[9]MaxInstOwn	0.024	0.881***	1				
[10]Top5InsOwn	0.007	0.759***	0.853***	1			
[11]Top10InstOwn	-0.015	0.658***	0.788***	0.977***	1		
[12]InstBlockOwn	0.024	0.698***	0.784***	0.963***	0.932***	1	
[13]InstOwn	-0.132	0.188*	0.529***	0.680***	0.764***	0.629***	1

*p<0.05,** p<0.01,*** p<0.001

Table 3 reports the summary statistics. In the final sample, the mean abnormal return (*AR*) on the event day is -0.003 percent. Insider purchase and insider net purchase ratio (*InsiderPnum, InsiderNPRnum, InsiderPshare, InsiderNPRshare, InsiderPmdollar, InsiderNPRmdollar*) are all negatively correlated with *AR*. Similarly, all the institutional ownership concentration variables (*InstOwnHHI, MaxInstOwn, Top5InstOwn, Top10InstOwn, InstBlockOwn*) are negatively correlated with *AR*. These results provide initial support for our hypotheses.

5.2. Main Results

H1, supported: We first examine whether investors react to the creation of a firm Wikipedia page. A classical event study is conducted, and the Patell Z is used as our statistic to test the significance of the abnormal returns (Patell, 1976). Table 6 presents the results of our analysis. The second column is the mean abnormal return calculated by the market model. The third column is the number of firms with positive/negative returns on the event day. The last column is the Patell Z test on the significance of the overall abnormal returns. As shown in Table 6, the mean abnormal return on the creation day of a firm Wikipedia page (day 0) is

-0.31%, significant at the 0.05 level. By contrast, there are no significant abnormal returns on days -2, -1, 1 or 2. This result supports H1, which predicts that the market will react negatively to the creation of a firm web page.

Table 4. Abnormal Returns of Wikipedia Events (Market Model)

Day/days	Abnormal Returns	Positive: Negtive	Patell Z
-2	-0.09%	64:75	-0.668
-1	-0.03%	72:67	0.025
0	**-0.31%**	**63:76**	**-2.057***
1	0.22%	78:61	1.481$
2	-0.12%	61:78	-0.404

*** p<0.001, ** p<0.01, * p<0.05, $ p<0.1 (using a generic one-tail test);

H2, partially supported: Here, we examine the crowd governance effect of Wikipedia on insider trades, by testing whether investors react more strongly to the creation of a Wikipedia page for firms with a greater proportion of insider trades. We regress the abnormal returns on the proportion of insider trades for a firm, including all firm and Wikipedia page control variables and run our regressions for each of our six measures of insider trade activity. The findings in Table 7 show significant results for four of our six measures. Therefore, we conclude that H2 is partially supported. Specifically, the coefficients for the three insider net purchase ratios (*InsiderNPRnum, InsiderNPRshare, InsiderNPRmdollar*) are -0.005, -0.004 and -0.004, respectively, with 0.002 standard deviation and significant at the 0.05 level. By contrast, the three insider purchase variables are partially significant. The coefficient of *InsiderPnum* is negative 0.007, with a 0.1 significance level. Although *InsiderPshare* and *InsiderPmdollar* are not significant, it is worth noting that their coefficients are negative. In sum, the results indicate that Wikipedia can play a role in regulating insider trading behavior, as indicated by our finding that investors react more strongly for firms with a greater proportion of insider trades.

Table 5. The Influence of Insider Trades on Market Return of Wikipedia Events

VARIABLES	(1) AR	(2) AR	(3) AR	(4) AR	(5) AR	(6) AR
InsiderPnum	-0.007*					
	(0.004)					
InsiderNPRnum		-0.005**				
		(0.002)				
InsiderPshare			-0.001			
			(0.000)			
InsiderNPRshare				-0.004**		
				(0.002)		
InsiderPmdollar					-0.033	
					(0.025)	
InsiderNPRmdollar						-0.004**
						(0.002)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.056***	-0.054***	-0.054***	-0.055***	-0.055***	-0.055***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Observations	139	139	139	139	139	139
Adjusted R-squared	0.376	0.389	0.375	0.383	0.370	0.383
F test	3.773	3.930	3.762	3.853	3.703	3.852

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

H3, supported: We next examine whether the magnitude of the stock market returns for a firm on its event day is associated with institutional ownership concentration by regressing the abnormal returns on firm institutional ownership concentration. We do so for each of our five ownership concentration measures. The findings presented in Table 8 indicate that all five variables of institutional ownership concentration are negative and significant at the 0.05 level. Interestingly, institutional ownership (*InstOwn*), which is not a measure of concentration, is insignificant. Together, these results support the crowd governance role of Wikipedia for firms with a highly concentrated ownership structure. That is, dominating shareholders respond negatively to the creation of a firm Wikipedia page as it reduces their information advantage. This result indicates that the private benefit theory dominates for the firms in our sample and we conclude that H3 is supported.

Table 6. The Influence of Institutional Ownership on Market Return of Wikipedia Events

VARIABLES	(1) AR	(2) AR	(3) AR	(4) AR	(5) AR	(6) AR
InstownHHI	-0.114**					
	(0.047)					
MaxInstOwn		-0.047**				
		(0.023)				
Top5InsOwn			-0.031**			
			(0.013)			
Top10InstOwn				-0.023*		
				(0.012)		
InstBlockOwn					-0.021**	
					(0.010)	
InstOwn						-0.011
						(0.009)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.048**	-0.050***	-0.046**	-0.046**	-0.052***	-0.051**
	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.020)
Observations	139	139	139	139	139	139
Adjusted R-squared	0.393	0.384	0.389	0.380	0.385	0.368
F test	3.973	3.868	3.931	3.825	3.878	3.681

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5.3. Robustness Check

Our first robustness check uses an alternative measure of abnormal returns. Instead of using CRSP-equally weighted index, we use CRSP-value weighted index in the market model to calculate the abnormal returns, and achieve highly consistent results. All the three hypotheses are still supported.

Our second robustness check uses different time windows to measure insider trades and institutional ownership concentration. In general, the results are qualitatively consistent and show support to H2 and H3. The insider trades data are at monthly level. We use the 1-month window in the main analysis, and now we try the 3-month, 6-month, and 12-month windows. The results of the 3-month window are qualitatively consistent with previous results. But while we use longer windows, the results become insignificant, which indicates that the insider trades varies over time. The institutional ownership data are at quarterly level. In our main analysis, we use the 1-quarter window. Now we try the 2-quarter, 3-quarter, and

4-quarter windows. The results remain significant and qualitatively the same.

6. Concluding Remarks

6.1. Major Findings

In this paper, we explore the question of whether Wikipedia changes the information environment of financial market. Specifically, we study whether Wikipedia plays a governance role by reducing the information advantage of certain types of investors. We design an event study to examine the market response to the creation of a firm Wikipedia page, conducting further cross-sectional analyses to study the reactions of firms with a greater proportion of insider trades or higher concentration of institutional ownership.

Our findings show that Wikipedia can reshape the information environment of the financial market by providing individual investors with a powerful collective platform with which to combat their information disadvantage. Our empirical evidence shows that the market reacts negatively to the creation of a firm Wikipedia page, consistent with the view that Wikipedia can weaken the information advantage of major market movers. Such a governance effect is achieved through the unique "wisdom of crowd" nature of Wikipedia. That is, individual investors use the aggregated, unbiased and timely information on Wikipedia to mitigate their information disadvantage.

Our cross-sectional analyses further show that the overall governance effect of Wikipedia is driven by the negative reaction of corporate insiders and large institutional investors to the creation of a firm Wikipedia page. We suggest that Wikipedia can thus complement central regulations in protecting individual investors and limiting the information advantage of insiders and large institutional investors. Our finding that Twitter does not elicit the same

reaction from these latter groups of investors provides further support for our hypothesis that the crowd generation function of Wikipedia aids individual investors.

6.2. Managerial Implications

This study has implications for corporate managers, institutional investors, individual investors, and policymakers in the financial market.

For managers and institutional investors, this study suggests that their information advantage is increasingly compromised by the advent of information aggregation achieved by social media channels such as Wikipedia. It becomes increasingly difficult for managers or institutional investors to maintain the same level of control over information. This evolution of information access may be a challenge, but also an opportunity if firms can understand how to utilize and respond to social media channels as a source of firm news.

For individual investors, our study suggests that individuals can benefit greatly from the information aggregation enabled by social media channels such as Wikipedia. Crowd wisdom is not a new term, but social media makes the information aggregation process more efficient and effective. Social media, which allow individuals to contribute and aggregate their information, provide a shortcut for crowd wisdom. Even without any substantial change in information access, the governance role played by social media channels such as Wikipedia can reduce information asymmetry and make the market more efficient.

Finally, for policymakers, our study suggests that regulators should understand how social media can complement their regulatory efforts. This is important as some regulations, such as SOX, have high implementation costs, especially for smaller firms (Chhaochharia and Grinstein 2007). In many situations, central regulations may bring about unintended

consequences. Our study shows a good example of how IT can offer a complementary way to resolve the challenges in the financial market.

6.3. Limitations and Future Research

As with all empirical research, this paper has several limitations. First, we do not directly test the impact of Wikipedia on insider trading and institutional investor trading. While our event study design alleviates the endogeneity problem, it is essentially a quasi-experiment research design with an assumption that the repeated effect over a long period is not likely to be random or induced by omitted variables (Mackinlay 1997, Binder 1998). In an effort to solve the omitted variable problem, we exclude concurrent events. The event study approach solves several challenges, but cannot provide us with a direct examination of the effects of Wikipedia on trading behavior.

Second, we use a narrow lens in our study by focusing on the corporate governance role of Wikipedia. However, Wikipedia may play other roles in the financial market, impacting liquidity, volatility, and information efficiency. These other roles are promising future directions for studying the impact of social media on the financial market.

Third, we focus on only Wikipedia. Different types of social media may play different roles in the financial market. Besides information aggregation, social media platforms exhibit other capabilities, such as Twitter's capability of information dissemination. Future studies can deepen our understanding by examining the roles of other social media in the financial market.

References

Ali, A., C. Durtschi, B. Lev, and M. Trombley. 2004. Changes in institutional ownership and subsequent earnings announcement abnormal returns. *J. Accounting, Auditing and Finance* **19** 221-248.

Antweiler, W., and M. Z. Frank. 2004. Is all that talk just noise? The information content of internet stock message boards. *J. of Finance* **59 (3)** 1259-1294.

Ba, S., and P. A. Pavlou. 2002. Evidence of the effect of trust building technology in electronic markets: Price premiums and buyer behavior. *MIS Quart.* **26 (3)** 243-268.

Barber, B.M., Y. Lee, Y. Liu, and T. Odean. 2009. Just how much do individual investors lose by trading? *Rev. Financ. Stud.* **22** 609-632.

Barclay, M., and C. Holderness. 1989. Private benefits from control of public corporations, *J. Financ. Econom.* **25** 371-395.

Barclay, M., and C. Holderness. 1992. The law and large-block trades. *J. Law and Econom.* **35** 265-294.

Bhojraj, S., and P. Sengupta. 2003. Effect of corporate governance on bond ratings and yields: The role of institutional investors and outside directors. *J. Business*. **76(3)** 455-475.

Binder, J. J. 1998. The event study methodology since 1969. *Rev. Quantitative Finance and Accounting* **11(2)** 111-137.

Blankespoor, E., G. S. Miller, and H. D. White. 2014. The role of dissemination in market liquidity: Evidence from firms' use of twitter. *Accounting Rev.* **89(1)** 79-112.

Bollen, J., H. Mao, X. Zeng. 2011. Twitter mood predicts the stock market. *J. Computational Sci.* **2** 1-8.

Brown, S. J., and J. B. Warner. 1985. Using daily stock returns: the case of event studies. *J. Financ. Econom.* **14 (1)** 3-31.

Bushee, B. J., D. A. Matsumoto, and G. S. Miller. 2004. Managerial and investor responses to disclosure regulation: The case of Reg FD and conference calls. *Accounting Rev.* **79(3)** 617-643.

Bushee, B. J., and T. Goodman. 2007. Which institutional investors trade based on private information about earnings and returns? *J. Accounting Res.* **45** 289-322.

Carleton, W., J. Nelson, and M. Weisbach. 1998. The influence of institutions on corporate governance through private negotiations: Evidence from TIAA-CREF. *J. Finance* **53** 1335-1362.

Chen, H., P. De, Y. Hu, and B. Hwang. 2014. Wisdom of crowds: the value of stock opinions transmitted through social media, *Rev. Financ. Stud.* **27(5)** 1367-1403.

Chhaochharia, V. and Y. Grinstein. 2007. Corporate governance and firm value: the impact of the 2002 governance rules. *J. Finance* **62(4)** 1789-1825.

Chiyachantana, C., C. Jiang, N. Taechapiroontong, and R. Wood. 2004. The impact of regulation fair disclosure on information asymmetry and trading: an intraday analysis. *Financ. Rev.* **39** 549-77.

Cohen, K. J., C. Malloy, and L. Pomorski. 2012. Decoding inside information. *J. Finance* **67(3)** 1009–1043.

Cremers, K. J., and V. B. Nair. 2005. Governance mechanisms and equity prices. *J. Finance* **60(6)** 2859-2894.

Dewan, S., and F. Ren. 2007. Risk and return of information technology initiatives: Evidence from electronic commerce announcements. *Inform. Systems Res.* **18(4)** 370-394.

Dos Santos, B. L., K. Peffers, D. C. Mauer. 1993. The impact of information technology investment announcements on the market value of the firm. *Inform. Systems Res.* **4(1)** 1-23.

Downs, A. 1957. An Economic Theory of Democracy. Harper & Brothers, New York.

Dyck, A., N. Volchkova, and L. Zingales. 2008. The corporate governance role of the media: Evidence from Russia. *J. Finance* **63(3)** 1093-1135.

El-Gazzar, S. 1998. Predisclosure information and institutional ownership: A cross-sectional examination of market revaluations during earnings announcement periods. *Accounting Rev.* **73** 119-129.

Fama, E.F. (1970) Efficient capital markets: A review of theory and empirical work. Journal of Finance, 25: 383–417.

Fama, E.F., and M. C. Jensen. 1983a. Separation of ownership and control. *J. Law and Econom.* **26(2)** 301-325.

Fama, E. F. and M. C. Jensen. 1983b. Agency problems and residual claims. *J. Law and Econom.* **26(2)** 327-349.

Francis, J., D. Nanda; and X. Wang. 2006. Re-examining the effects of regulation fair disclosure using foreign listed firms to control for concurrent stocks. *J. Accounting and Econom.* **41** 271-92.

Frankel, R., and Li, X., 2004. Characteristics of a firm's information environment and the information asymmetry between insiders and outsiders. *Journal Accounting and Econom.* **37** 229–259.

Gu, B., J. Park and P. Konana. 2012. Research note - The impact of external word-of-mouth sources on retailers sales of high involvement products. *Inform. Systems Res.* **23 (1)** 182-196.

Hartzell, J. C. and T. Laura. Institutional investors and executive compensation. *J. Finance* **58(6)** 2351-2374.

Healy, P., A. Hutton, and K. Palepu. 1999. Stock performance and intermediation changes surrounding sustained increases in disclosure. *Contemporary Accounting Res.* **16 (3)** 485-520.

Heflin, F., K. R. Subramanyam, and Y. Zhang. 2003. Regulation FD and the financial information environment: Early evidence. *Accounting Rev.* **78(1)** 1-37.

Im, K. S., Dow, K. E., and Grover, V. 2001. A reexamination of IT investment and the market value of the firm-an event study methodology. *Inform. Systems Res.* **12(1)** 103-117.

Iskander, M. R. and N. Chamlou. 2000. Corporate governance: A framework for implementation. *Washington, DC: World Bank.*

Jagolinzer, A., D. F. Larcker, and D .J. Taylor. 2011. Corporate governance and the information content of insider trades. *J. Accounting Res.* **49(5)** 1249-1274.

Jensen, M. 1986. Agency costs of free cash flow, corporate finance, and takeovers. *American Econom. Rev.* **76** 323-329.

Kankanhalli, A., B. C-Y. Tan, and K-K. Wei. 2005. Contributing knowledge to electronic knowledge repositories: An empirical investigation. *MIS Quarterly* **9(1)** 113-143.

Ke, B., S. Huddart, and K. Petroni. 2003. What insiders know about future earnings and how they use it: Evidence from insider trades. *J. Accounting and Econom.* **35** 315–346.

Ke, B., K. R. Petroni, and Y. Yu. 2008. The effect of Regulation FD on transient institutional investors' trading behavior. *J. Accounting Res.* **46(4)** 853–883.

La Porta, R., F. Lopez-de-Silanes, A. Sheleifer, and R. Vishny. 1998. Law and finance. *J. Political Economy* **106(6)** 1114-1154.

La Porta, R., F. Lopez-de-Silanes, A. Sheleifer, and R. Vishny. 2000. Investor protection and corporate Governance. *J. Financ. Econom.* **58** 3-27.

Lakonishok, J. and I. Lee. 2001. Are insider trades informative? Are insider trades informative? *Rev.of Financ. Stud.* **14(1)**:79-111.

Li, X., S. Radhakrishnan, H. Shin, and J. Zhang. 2011. Regulation FD, accounting restatements, and transient institutional investors' trading behavior. *J. Accounting and Public Policy* **30(4)** 298-326.

Luo, X., J. Zhang, and W. Duan. 2013. Social media and firm equity value. *Inform. Systems Res.* **24(1)** 146-163.

MacKinlay, A. C. 1997. Event studies in economics and finance. *J. Econom. Literature* **35(1)** 13-39.

Marin, J. and J. P. Oliver. 2008. The Dog That Did Not Bark: Insider Trading and Crashes. *J. Finance* **63(5)** 2429-2476.

Moat, H. S., C. Curme, A. Avakian, D. Y. Kenett, H. E. Stanley, and T. Preis. 2013. Quantifying Wikipedia usage patterns before stock market moves. *Nature* **3**, Article number: 1801.

Odean, T. 1999. Do investors trade too much? *American Econom. Rev.* **89** 1279-1298.

Patell, J. 1976. Corporate forecasts of earnings per share and stock price behavior: Empirical tests. *J. Accounting Res.* **14 (2)** 246-76.

Ranganathan, C., and C. V. Brown. 2006. ERP investments and the market value of firms: toward an understanding of influential ERP project variables. *Inform. Systems Res.* **17(2)** 145-161.

Ravina, E. and P. Sapienza. 2010. What do independent directors know? Evidence from their trading. *Rev. Financ. Stud.* **23** 962-1000.

Roberts, G. and L. Yuan 2010. Does institutional ownership affect the cost of bank borrowing? *J. Econom. and Business* **62(6)** 604-626.

Rubin, A. and E. Rubin. 2010 Informed investors and the Internet. *J. Business Finance and Accounting* **37(7) & (8)** 841–865.

Scott, J., and P. Xu. 2004. Some insider sales are positive signals. *Financial Analysts J.* **60** 44-51.

Seyhun, H. N. 1986. Insiders' profits, costs of trading, and market efficiency. *J. Financ. Econom.* **16** 189-212.

Seyhun, H. N. 1992. Why does aggregate insider trading predict future stock returns? *Quart. J. Econom.* **107(4)** 1303-1331.

Shleifer, A., and R. W. Vishny. 1986. Large shareholders and corporate control. *J. Political Economy* **94** 461-488.

Shleifer, A., and R. W. Vishny, 1997. A Survey of corporate governance. *J. Finance* **52(2)** 737-783.

Stein, E. W., and V. Zwass. 1995. Actualizing organizational memory with information systems. *Inform. Systems Res.* **6(2)** 85-117.

Surowiecki, J. 2004. The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies and nations. *New York: Doubleday*.

Tambe, P. and L. Hitt. 2012. The productivity of information technology investments: New evidence from IT labor data. *Inform. Systems Res.* **23 (3-1)** 599-617.

Tirunillai, S. and G. J. Tellis. 2012. Does chatter really matter? Dynamics of user-generated content and stock performance. *Marketing Sci.* **31(2)** 198-215.

Utama, S., and W. Cready. 1997. Institution ownership, differential predisclosure precision and trading volume at announcement dates. *J. Accounting and Econom.* **24** 129-150.

Xu, X. and X. Zhang. 2013. Impact of Wikipedia on market information environment: Evidence on management disclosure and investment reaction. *MIS Quart.* **37(4)** 1043-1068.

Zhang, X. 2007. Economic consequences of the Sarbanes-Oxley Act of 2002. *J. Accounting and Econom.* **44** 74–11.