Can Internet-based disclosure reduce information asymmetry?

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ABSTRACT

The Internet is widely used by listed companies to manage investor relations. Since January 2007, the French Financial Authority has required companies listed on Euronext-Paris to disclose all mandatory financial information via the Internet in order to enhance information transparency. This paper examines the impact of Internet-based disclosure on the French stock market by analyzing the relationship between information asymmetry and Internet disclosure practices. Extending previous studies on Web-based disclosure, a checklist of 40 items is developed to evaluate the level of Internet-based voluntary disclosure. Measuring information asymmetry by the spread and the probability of informed trading, we show that greater Web-based disclosure lowers information asymmetry in the French financial market.

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1. Introduction

The Internet has triggered a revolution in the area of financial transparency for both listed companies and investors in financial markets. Compared with traditional media, such as the paper-based annual report, the Internet allows firms to aggregate and disseminate different types of information (video, sound, flash, text, etc.) on their websites. Internet disclosure offers firms the opportunity to enhance communication quality, improve reputation, attract potential investors, and reduce information distribution costs (Ettredge, Richardson, & Scholz, 2002). As a consequence, firms that improve their communication to investors may reduce their cost of capital. The investors may also benefit from Web disclosure, because Internet-based technologies facilitate the information gathering process. Via the Internet, investors can very quickly obtain different types of financial information, which is presented in various formats (Word, Excel or Pdf, etc.) and is directly usable. Web disclosure may also help investors to bridge the information gap between themselves and managers. Moreover, as Web information is widely disseminated, it may be able to reduce the information asymmetry between informed and uninformed investors. As Hodget, Kennedy, and Maines (2004) point out, Internet technology helps investors to access, analyze and understand information, which, in turn, leads to better interpretation.

This paper attempts to develop a better understanding of the effects of Internet-based voluntary disclosure on the French stock market. The main purpose is to determine whether Internet disclosure could lead to a reduction in information asymmetry. Based on the works of Pirchegger and Wagenhofer (1999), Debreceny, Gray, and Rahman (2002), Ettredge et al. (2002) and Marston and Polei (2004), a checklist of 40 items is developed to assess the level of Web disclosure. Moreover, this checklist takes into account not only the quantity of information available via the Internet, but also the presentation of information on websites. Information asymmetry is measured by the spread, the probability of informed trading (PIN) defined by Easley, Kiefer, O’Hara, and Paperman (1996) and the adjusted probability of informed trading (AdjPIN) extended by Duarte and Young (2009). Our empirical findings show a negative relationship between Internet-based disclosure and information asymmetry.

This paper also extends prior studies on Web-based disclosure in several ways. Firstly, instead of studying the determinants of Web-based disclosure, we focus on the consequences of this new information dissemination channel and try to extend the existing empirical studies on the impact of financial disclosure on information asymmetry. Several researchers have already investigated this relationship, but through using traditional communication channels (annual reports, preliminary announcements, earnings announcements, financial analysts’ information, etc.). For example, Petersen and Plenborg (2006) found a negative relationship between the amount of financial information published via annual reports and information asymmetry. By using the Association of Investment Management and Research (AIMR) total disclosure scores as a proxy for a firm’s disclosure quality, Brown and Hildegeist (2007) prove that there is a negative association between disclosure quality and information asymmetry.
Secondly, several empirical papers investigate the impact of electronic communication on asymmetry by analyzing the adoption of XBRL\(^2\). They show that the technique of XBRL improves financial transparency and reduces information asymmetry in the capital market (Pinsker & Li, 2008; Yoon, Zo, & Ciganek, 2011). Instead of focusing on one single Web disclosure technology, we study the overall level of company website-based disclosure and its impact on the French capital market. A sophisticated checklist is developed to cover not only the content of voluntary disclosure online, but also the presentation of online disclosure.

Thirdly, this paper provides empirical evidence of the impact of Web disclosure on information asymmetry in the French institutional context. Up until now, most empirical studies on information asymmetry and voluntary disclosure have been developed using American samples. Few works, except those of Leuz and Verrecchia (2000), Hall (2002) and Petersen and Plenborg (2006), have focused on European companies, and none have studied French listed companies. As Jaggi and Low (2000) show, the legislative system and culture influence financial practices. Compared with Anglo-American firms, the capital concentration of French firms is relatively high and generally characterized by state, family or cross-shareholding. Investor protection is also weaker in France than in the U.S. In light of these differences, it is valuable to examine whether the results obtained through empirical studies using other samples are valid in the case of France. While quarterly earnings announcements are legally required in the US, French firms generally publish semi-annual earnings\(^3\). Ciganskew and Quéré (2013) study the effect of earnings disclosures on information asymmetry in France and the US and prove that the lower frequency of earnings announcements in France induces a steeper decrease of information asymmetry at the time of release of semi-annual earnings.

Lastly, empirical studies on information asymmetry generally use the spread-based measure as a proxy for information asymmetry. This metric lacks precision in the sense that spreads do not only represent adverse selection costs. The paper here estimates the probability of informed trading in order to capture more precisely the extent of information asymmetry on the stock market (Duarte & Young, 2009; Easley et al., 1996).

2. The regulation of information disclosure in France

As part of the European continental system, the French accounting disclosure regulation is less equity-outsider oriented than the Anglo-American system (Nobes, 1998). For instance, French regulations do not require firms to publish their results for the first and third quarters, while all four quarterly earnings announcements are legally required in the US. French firms generally publish semi-annual earnings\(^4\). Ciganskew and Quéré (2013) study the effect of earnings disclosures on information asymmetry in France and the US and prove that the lower frequency of earnings announcements in France induces a steeper decrease of information asymmetry at the time of release of semi-annual earnings.

In France, Internet financial disclosure has been voluntary and unregulated for many years. In order to guarantee a high level of investor protection and efficient markets, the European transparency directive (2004/109/CE) has established the detailed requirements for disclosure of periodic and on-going information concerning issuers whose securities are already admitted to trading on a regulated market\(^5\). France has adopted this directive and modified the AMF’s General Regulations (Book II: Issuers and financial disclosure)\(^5\). Since January 2007, all listed companies on Euronext-Paris must ensure that the regulated information is disseminated effectively and in full. Furthermore, the regulated information should be posted “on its website as soon as it has been disseminated” and be kept as stored data for at least five years. These new regulations are designed to improve the integrity of the information dissemination system, reduce the opacity of financial statements, and protect investors from accounting fraud. Appendix A provides a summary of regulated financial information for the firms listed on the French capital market.

3. Literature review and hypotheses

3.1. Literature review on Internet-based disclosure

Studies on Web-based disclosure started in the mid-1990s when the Internet began to have a powerful impact on culture and the business environment. The research from this early stage is generally descriptive, with most studies providing an overall observation of the extent of Internet-based disclosure internationally (Deller, Stubenrath, & Weber, 1999; Ettredge, Richardson, & Scholz, 2001; Gowthorpe & Amat, 1999; Gray & Debreceny, 1997; Petrovick & Gillett, 1996; Trites, 1999).

By extending the earlier descriptive studies on Internet-based disclosure, more recent studies have sought to explain the determinants of Internet-based disclosure (Ashbaugh, Johnston, & Warfield, 1999; Brennan & Hourigan, 2000; Craven & Marston, 1999; Debreceny et al., 2002; Ettredge et al., 2002; Marston & Polei, 2004; Pircherger & Wagenhofer, 1999; Trabelsi, Labelle, & Dumontier, 2008). Since the release of information via the Internet has been a voluntary choice for the listed companies for several years, these studies have introduced agency theory, signal theory and cost–benefits analyses, which are generally used in voluntary disclosure studies. It is assumed that these theories can explain voluntary disclosure via both the traditional media, such as annual reports, and the new channels, such as the Internet (Marston & Polei, 2004; Trabelsi et al., 2008).

One common finding in prior studies is the positive relationship between firm size and Web reporting. The empirical results from different countries show that firm size is the most important determinant of the Internet used to disseminate information. As Buzzy (1975) points out, the cost of information disclosure is relatively low for larger firms. Furthermore, large companies are more exposed to public scrutiny. As a result, they are motivated to enhance information transparency to satisfy the needs of information users.

It is generally accepted that corporate governance factors can influence a company’s communication strategy, particularly regarding voluntary disclosure (Ainikya, Bhujraj, & Sengupta, 2005; Gul & Leung, 2004; Velury & Jenkins, 2006). Kelton and Yang (2008) extend these studies by focusing on the relationship between governance mechanisms and voluntary Web disclosure. They show that better Internet-based disclosure is positively linked to weaker shareholder rights, lower capital concentration, a higher percentage of independent directors and financial experts on the board, and a greater frequency of audit committee meetings. The findings of Kelton and Yang (2008) emphasize the importance of corporate governance in Web practices. On the contrary, Alali and Romero (2012) find that highly concentrated firms in Argentina disclose more information on their websites than firms with less concentration.

Later, empirical research began to investigate the effects of Internet-based disclosure on the financial market. For example, Cormier, Aerts, Ledoux, and Magnan (2009) find a negative impact of the Web-based social and human capital disclosure on stock volatility and Tobin’s Q. Yoon et al. (2011) show that the technique of XBRL improves financial transparency and reduces information asymmetry in the capital market. Blankespoor, Miller, and White (2014) find that dissemination via Twitter is negatively associated with information asymmetry. Efendi, Park, and Smith (2014) show that XBRL filings can improve informational efficiency because XBRL filings make the financial data easier to use and analyze for all the information users. Chang, D’Anna, Watson, and Wee (2008) examine the relationship between information asymmetry and

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\(^2\) XBRL: eXtensible Business Reporting Language.


\(^4\) AMF (“Autorité des Marchés Français”) stands for French Financial Authority.

\(^5\) The publication of quarterly accounts by French firms on 1st and 3rd quarters is not mandatory. Only turnover publication is required.

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Internet-based disclosure in Australia. They find that the bid–ask spread is negatively related to disclosure quality, but this relationship becomes weaker in the presence of other factors. Based on the preceding research, higher Internet-based voluntary disclosure should reduce the degree of information asymmetry.

3.2. Development of hypotheses

Situations concerning information asymmetry are more likely to occur when some informed investors possess information that others, the uninformed, do not have. These situations are detrimental to firms when the informed investors trade using this informational advantage, such as through insider trading. These trades lead to an adverse selection problem, because the uninformed will flee the market if they detect such information asymmetry. In order to keep the uninformed in the market and trade with them, the informed would have to revise their bids. This creates an adverse selection problem that could be resolved through increased disclosure, such as Web-based disclosure, by the firms.

Theoretical research shows that the release of public information may, both directly and indirectly, help to reduce information asymmetry. On the one hand, the publication of accounting information should lower the informational advantage of pre-informed agents, and therefore the extent of information asymmetry. Using this argument, Verrecchia (1982) treats public disclosure as a substitute for and therefore the extent of information asymmetry. On the one hand, the publication of accounting information may, both directly and indirectly, help to reduce information asymmetry by reducing the incentive for investors to acquire costly private information. The theoretical models of Kim and Verrecchia (1991), Demski and Feltham (1994) and McNichols and Trueman (1994) show that some agents are highly motivated to acquire private information before publication of the financial results, and are able to benefit from this advantage before it is neutralized by the corresponding report but, if firms increase their public disclosure, the incentive for investors to search for costly private information will be reduced (Diamond, 1985; Fama & Laffer, 1971; Hakansson, 1977). Brown and Hillegeist (2007) empirically show that the incentive to collect private information declines with disclosure quality.

The release of public information may also change the trading behavior of uninformed investors on the capital market, according to the investor recognition hypothesis (Merton, 1987). Internet-based disclosure can in fact enhance a firm’s visibility and mitigate incomplete information. As investors prefer to invest in companies with which they are familiar, more investors will be attracted to trade in the stock (Fishman & Hagerty, 1989). As a result, information coverage (analysts, press coverage) will increase, thus leading to a reduction in information asymmetry, ceteris paribus. However, the larger the investor base, the higher the probability of informed trading. Kyle (1985) theoretically demonstrates that the informed could have an incentive to increase their trades when there are more uninformed investors in the market. Their strategies become even less visible with more uninformed investors in the market. Although information asymmetry in the market depends on the balance between the informed and the uninformed, Brown and Hillegeist (2007) empirically prove that the balance between the informed and the uninformed changes in favor of uninformed trading with disclosure quality. This is probably due to limited capital constraints and risk aversion. To sum up, Internet-based voluntary disclosure may reduce situations of information asymmetry, because the informed have less incentive to acquire private information.

Empirically, Heflin, Shaw, and Wild (2005) demonstrate that increased disclosure (measured by analysts’ evaluations) is associated with lower spreads. Petersen and Plenborg (2006) also prove that quoted companies can reduce the spread by publishing more information voluntarily. Brown and Hillegeist (2007) find a negative relationship between the quality of annual report disclosure and information asymmetry. This negative association becomes stronger when the initial level of information asymmetry between the firm and investors is higher.

Public information disclosure concerns not only content, but also presentation. The adoption of online disclosure enhances a firm’s capacity to present information and make its homepage a user-friendly information center. For example, search engines facilitate finding information, especially for novice investors with little experience. Financial data in Excel format facilitate the processing of data. Hyperlinks make it easier for investors to compare firm stock with market indexes. Furthermore, the Internet makes real-time disclosures accessible to all investors, and this is particularly important for foreign investors, who experience greater difficulties with information collection via traditional media. The organization of the website may improve disclosure quality and, as this can reduce information asymmetry, the presentation is a means of lowering this asymmetry.

Prior empirical studies have shown the positive impact of some Web technologies on information asymmetry. For example, the XBRL technique can improve financial transparency and reduce information asymmetry in the capital market (Yoon et al., 2011). Later, Efendi et al. (2014) prove that XBRL filings can improve informational efficiency. Based on the preceding arguments and research, greater use of network technology should reduce the level of information asymmetry. This leads to the core hypothesis:

**Hypothesis.** There is a negative relationship between information asymmetry and the degree of Internet-based voluntary disclosure.

4. Research design

The empirical investigation consists of observing the relationship between Internet-based disclosure and information asymmetry.

4.1. Sample description and data collection methods

The initial sample contains publicly traded French companies belonging to the SBF 250 index. We excluded twenty-nine companies in the financial sector due to their disclosure practices, which are heavily influenced by regulatory requirements (Botosan, 1997) and subject to different disclosure requirements. Forty-one companies were also rejected for lack of sufficient information. The final sample therefore consists of 180 companies covering nine sectors: Oil and Gas, Basic Materials, Industrials, Consumer Goods, Health Care, Consumer Services, Telecommunications, Utilities and Technology. Table 1 presents the elements of the research sample.

Data on ownership structure were extracted from Thomson ONE Banker. Information on corporate governance was collected from websites and annual reports. Other financial and accounting data were obtained from Datastream and Worldscope. All data relate to the 2007 financial year.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Oil and Gas</td>
<td>6</td>
<td>3.33%</td>
</tr>
<tr>
<td>Basic Materials</td>
<td>4</td>
<td>2.22%</td>
</tr>
<tr>
<td>Industrials</td>
<td>41</td>
<td>22.78%</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>38</td>
<td>21.11%</td>
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<tr>
<td>Health Care</td>
<td>14</td>
<td>7.78%</td>
</tr>
<tr>
<td>Consumer Services</td>
<td>34</td>
<td>18.89%</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>2</td>
<td>1.11%</td>
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<tr>
<td>Utilities</td>
<td>6</td>
<td>3.33%</td>
</tr>
<tr>
<td>Technology</td>
<td>35</td>
<td>19.44%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>180</strong></td>
<td><strong>100.00%</strong></td>
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4.2. Measurement of variables

4.2.1. Information asymmetry measurement

In order to study the relationship between information asymmetry and firm reporting on the Internet, we first need to assess the extent of information asymmetry in the stock market. Prior research has developed various methods of assessing the level of information asymmetry. Of these, the bid–ask spread (difference between the best selling price and the best buying price for a given security) appears to be the most frequently-used proxy to measure information asymmetry in previous studies on accounting information (Leuz & Verrecchia, 2000; Petersen & Plenborg, 2006; Welker, 1995).

Being consistent with prior works (Petersen & Plenborg, 2006; Yoon et al., 2011), this study also uses the spread as a proxy of information asymmetry and calculates the relative spread (R_Spread) by the following formula:

$$ R_{\text{Spread}} = \frac{(\text{Ask price} - \text{Bid price})}{(\text{Bid price} + \text{Ask price})/2} $$

where: R_Spread is the average quoted spread.

As stocks in the sample are continuously traded, we compute also time-weighted average bid–ask spreads (W_Spread) and average effective spreads (E_Spread) from time-stamped data. Assuming that there are N quotation updates in the interval [t0; tN], the time-weighted average bid–ask spread is then computed using the following formula:

$$ W_{\text{Spread}} = \frac{1}{(t_N - t_0)} \sum_{i=1}^{N} \text{Spread}_i \times (t_i - t_{i-1}) $$

where: W_Spread is the time-weighted average bid–ask spread.

The effective spread is computed by comparing the mid-price to the trading price:

$$ E_{\text{Spread}} = 2 \times \frac{(\text{Trading price} - (\text{Bid price} + \text{Ask price})/2)}{(\text{Bid price} + \text{Ask price})/2} $$

where: E_Spread is the average effective spread.

However, the bid–ask spread measures transaction costs that also include other components. In an order-driven market, there could also be a component linked to inventory costs and another linked to asymmetric information costs. To some extent, spreads do not measure adverse selection costs exactly.

In order to have more robust results, we rely on the model developed by Easley, Kiefer, and O’Hara (1997) to measure information asymmetry. Their model allows the probability of informed trading to be estimated from the order flow. We computed the PIN measure defined by Easley et al. (1996), which is based on trade direction. The probability of observing B buys and S sells on a given day can be expressed as follows:

$$ P_i \{B_i, S_i \} = \frac{1}{(\text{Ask price} - \text{Bid price})} \sum_{i=1}^{N} \text{Spread}_i \times (t_i - t_{i-1}) $$

where: PIN is the probability of informed trading defined by Easley et al. (1996).

The PIN measure may also include potential effects of liquidity unrelated to information asymmetry. In order to control these effects, we have also computed the adjusted measure of PIN developed by Duarte and Young (2009). AdjPIN is calculated as:

$$ \text{AdjPIN} = \frac{\epsilon \mu}{\epsilon \mu + 2\epsilon \Delta} $$

where: AdjPIN is the adjusted PIN developed by Duarte and Young (2009), \( \epsilon \) is the rate of uninformed buy and sell trade, and \( \mu \) is the rate of informed buy and sell trade.

Over an observation period of \( T \) days, the likelihood of observing \( (B_i, S_i)^T \) buys and sells corresponds to the product of the daily likelihoods:

$$ L((B_i, S_i)^T) = \prod_{t=1}^{T} L((B_i, S_i) | (\alpha, \delta, \mu, \epsilon)). $$

In order to estimate the parameters, we maximize the likelihood defined in Eq. (5), and the PIN is calculated as:

$$ \text{PIN} = \frac{\alpha \mu}{\alpha \mu + 2 \epsilon \Delta} $$

where PIN is the probability of informed trading defined by Easley et al. (1996).

The PIN measure may also include potential effects of liquidity unrelated to information asymmetry. In order to control these effects, we have also computed the adjusted measure of PIN developed by Duarte and Young (2009). AdjPIN is calculated as:

$$ \text{AdjPIN} = \frac{\epsilon \mu}{\epsilon \mu + 2 \Delta \times (\alpha \epsilon \mu + (1 - \alpha) \epsilon \delta) + 2 \epsilon} $$

where:

- \( \epsilon \) is the rate of uninformed buy and sell trade.
- \( \mu \) is the rate of informed buy and sell trade.
- \( \alpha \) is the rate of a probability of an information event that is bad news with probability \( \delta \).

4.2.2. Development of the index of Internet disclosure

Two methods are generally used to assess the level of information disclosure. The direct method uses estimates published by professional institutions that regularly assess the supply of information by quoted companies. For example, the Association for Investment and Management Research (AIMR) publishes an annual ranking of financial transparency in a report giving assessments by analysts on the disclosure practices of firms that has been used as a proxy of disclosure policy in many prior studies (Bamber & Cheon, 1998; Botosan & Plumlee, 2002; Brown & Hillegeist, 2007; Healy, Hutton, & Palepu, 1999; Lang & Lundholm, 1993, 1996; Sengupta, 1998; Welker, 1995).

The indirect method uses an assessment index created by researchers. Since the work of Pirchegger and Wagenhofer (1999), the measurement of Internet-based disclosure has become increasingly sophisticated. This can be seen not only in the increase in the number of items on the checklist, but also by the introduction of new criteria in the division of items. Ettredge et al. (2002) use a checklist of items that distinguishes the SEC from the AIMR and the AMF. Since the work of Pirchegger and Wagenhofer (1999), the measurement of Internet-based disclosure has become increasingly sophisticated. This can be seen not only in the increase in the number of items on the checklist, but also by the introduction of new criteria in the division of items. Ettredge et al. (2002) use a checklist of items that distinguishes the SEC from the AIMR and the AMF.

We first summarize all the items used in these prior studies on firm reporting via the Internet. In order to limit our study to the field of voluntary disclosure, all the mandatory items (according to the AMF...
regulations) are excluded from the index. Second, we choose the items according to the focus of the study. The main objective of this study is to test whether the technological features of Internet disclosure can reduce information asymmetry. As a result, all items of this nature in the previous works are given priority consideration. Internet disclosure is generally considered as “timely” and “user-friendly.” In addition, we want to emphasize the “compatibility” of the website. The Internet is a multimedia that assembles paper-based reports, video and voice documentations, etc. For this reason, some items, which are considered to be information in prior research, can also be treated as an advantage of the Internet disclosure presentation in our study. We also introduce some new items, which have not been used in prior studies but are closely related to the technological features and advantages of Internet disclosure.

We assign one point to each item presented on the firm’s own website and which is available to the general public. The maximum possible score that a listed firm can obtain is 40 points. For each company, the total score is presented as the percentage of the actual score in relation to the maximum possible score. Therefore, the level of Internet-based disclosure (Score) of each company varies between 0 and 1, with 1 being the highest score and 0 the lowest.

We want to point out that only the items presented on a HTML webpage can be considered in the data collection. The information contained in the annual or semester reports (PDF or Word format) was not scored in order to avoid repetition. We have focused on the investor section which regroups all the important information for investors. However, we also consider the complete firm website because several technological feature items (such as “help site” “site plan”, “internal search engine”) of our index are designed for the whole website. All the firms’ websites in our sample were analyzed during the months of May and June in 2007. The entire index is presented in Appendix B.

4.2.3 Analysis method

The main purpose of this study is to analyze how Internet disclosure is related to information asymmetry. When studying this relationship, the reverse causality between these two factors should be considered. As prior research points out, disclosure can reduce the level of information asymmetry, and firms that experience high information asymmetry may be more persuaded to release information so as to limit the adverse selection problem. Eberlein and Weischenberg (1995) suggest that the potential endogeneity problem, we run a Hausman (1978) test in order to choose between the OLS and the 2SLS methods. A dummy variable called governance system (Goverance) is introduced as an instrumental variable in our tests. Governance is a binary variable defined to measure the governance system: one-tier firms are coded 0, while two-tier firms are coded 1.

In fact, the French legislation allows domestic publicly-listed companies to choose between a one-tier system, mandatory in the Anglo-American system, and a two-tier system, which is mandatory in countries such as Germany or Slovenia for example. This opportunity is unique in Europe. Because the two-tier system clearly separates the functions of management and control, it is supposed to provide a more effective management style. Therefore, the two-tier system should be associated with higher disclosure quality (Charreaux, 1997). Furthermore, no prior literature suggests that the government system may have a direct impact on information asymmetry.

In addition to Internet-based disclosure, a series of variables was also incorporated in the regression model to analyze the determinants of information asymmetry. These include turnover, stock return volatility, share price and ownership concentration. The selection of the control variables is based on prior literature (Chang et al., 2008; Lang & Lundholm, 1993; Leuz & Verrecchia, 2000; Petersen & Plenborg, 2006, etc.).

4.2.4 Trading volume (turnover)

From a theoretical point of view, there are several arguments supporting the fact that trading volume should reduce information asymmetry and also the bid–ask spread. Copeland and Galai (1983) study information effects on the spread and show that the bid–ask spread and also information asymmetry is a negative function of measures of trading activity. In their model, the probability of informed trading is higher for thinly traded stocks, because these stocks are on average more closely held. As a consequence of holding the size as constant, low trading volume means less frequent trading. Thus, trading volume is negatively associated with information asymmetry and bid–ask spreads. This explanation holds if the size of transaction remains constant. Moreover, if we focus on information asymmetry, trading volume captures the degree of trading activity and stock market liquidity. It indicates the willingness of market participants to sell and buy shares. Leuz and Verrecchia (2000) suggest that trading activity reflects the attractiveness of a stock. Stocks with higher liquidity are relatively more attractive to investors, and this could improve the degree of public information (analysts, press coverage) and reduce information asymmetry to this extent. Finally, Ho and Stoll (1981) predict that trading volume should reduce spreads due to economies of scale. Among the different measures of volume, the rotation rate would seem to be the metric with the best properties. Consequently, we define trading volume as:

\[
\text{Turnover} = \log \frac{\text{Daily trading volume}}{\text{NOSH} \times \text{NOSHFF}}
\]

where:

- Turnover is the rotation rate of stocks
- Daily trading volume is the total number of traded shares on a given day
- NOSH is the total number of ordinary shares
- NOSHFF is the free-float percentage of total shares available to ordinary investors

All variables were extracted from Datastream.

4.2.5 Stock return volatility (volatility)

Stock return volatility should enhance the bid–ask spread due to risk-bearing (Glosten, 1987; Roll, 1984). In the capital market, stock return volatility generally indicates the degree of uncertainty or risk. In this case, the risk of not holding an optimal position increases. As a consequence, higher volatility leads to greater spreads. Copeland and Galai (1983) insist on the role of specific risk in their model. As specific risk increases, information asymmetry should also increase. Stock return volatility (Volatility) is measured by the standard deviation of daily stock returns.

4.2.6 Stock price (InPrice)

Price level allows for the effect of discreetness to be controlled. Stocks with low price levels tend to be new, smaller in size and above all riskier. This additional risk leads to an enlargement of the bid–ask spread. Stoll (2000) has proved that the relative spread is negatively related to the price level in logarithm. The stock price (InPrice) is therefore measured as the logarithm of the stock price.

\[\text{InPrice} = \log \text{Stock price} \]
4.2.7. Ownership concentration (Bloc)

Agency theory suggests that individual investors are in an unfavorable informational position relative to managers and majority shareholders. Therefore, when ownership structure is more dispersed, the risk of information asymmetry is more likely to be effective. These situations increase agency problems and imply higher monitoring costs. The study of Glosten and Milgrom (1988) points out that large shareholders attempt to trade on their insider information and extract private benefits and firm control. Such an agency problem results in a larger spread and lower stock liquidity. Moreover, Attig, Fong, Cadhoun, and Lang (2006) provide empirical evidence on the positive relationship between ownership concentration and information asymmetry. Therefore, it is supposed that the ownership concentration is positively linked to the level of information asymmetry. Ownership concentration (Bloc) is measured by the proportion of capital held by blockholders (investors owning 5% or more of a firm’s stock).

The next equation summarizes the regression model:

\[
\text{Information asymmetry} = \alpha + \beta_1 \text{Internet-based Disclosure} + \beta_2 \text{Turnover} + \beta_3 \text{Volatility} + \beta_4 \text{Price} + \beta_5 \text{Bloc} + e. 
\]  

5. Empirical results

5.1. Descriptive statistics

The descriptive statistics are set out in Table 2. The results of the overall Internet-based voluntary disclosure (Score) indicate that the highest score achieved by any company is 0.85, while the lowest is 0.125. The mean value is 0.422. These results suggest that, across the 180 listed companies in the sample, there is widespread variation in the global level of voluntary disclosure via the Internet.

As far as information asymmetry is concerned, relative spreads vary from 0.04% to a maximum of 4.23%. The means are 0.68% and 0.70% respectively for three and six months. By comparison, Yoon et al. (2011) find a mean of 0.7% for the South-Korean market over the period 2007–2008. The mean of the PIN estimates over three and six months is respectively equal to 0.1818 and 0.1794, which is consistent with the estimation given by Easley, Hvidkjaer, and O’Hara (2002). Duarte and Young (2009) calculate a median for adjusted PIN equal to 0.17, a result confirmed by our estimates of 0.14 and 0.15 respectively for three and six months.

On average, 51.3% of the outstanding shares are held by blockholders. With an American sample, Kelton and Yang (2008) highlight that the average percentage of capital held by block shareholders is about 20%. Marston and Polei (2004) show that the average free-float coefficient of German listed companies is 42.75%. Compared with their counterparts, the French companies have a much higher concentration of capital.

5.2. Correlation analysis

Panel A of Table 3 shows the correlation of a three month period while Panel B presents a six month period. Both show the Pearson correlations between information asymmetry and the explanatory variables. At first, the five measures of information asymmetry (Relative Spread, time-weighted quoted spreads, effective spreads, PIN and AdjPIN) are significantly and positively related one to another. The level of Internet-based voluntary disclosure (Score) is negatively related to all these measures of information asymmetry. A higher level of information disclosure through the Internet may lead to a lower level of information asymmetry.

Moreover, the variables Spread, PIN and AdjPIN are also negatively related to the turnover ratio, and to the standard-deviation of stock returns. These results are consistent with previous empirical findings in the field of market microstructure (e.g., Huang & Stoll, 1996; Stoll, 2000; Venkataraman, 2001). The ownership concentration (Bloc) is negatively related to Web disclosure but positively linked to all the information asymmetry measures.

We also find that the variable governance is negatively related to the Internet-based disclosure. The result suggests that the firms under the one-tier government system release more information via the Internet. It seems that the French firms use the two-tier system as a substitute for information transparency. Furthermore, no significant relationship between governance and the information asymmetry measures is observed. We may therefore use governance as an instrumental variable in the regression tests.

5.3. Regression estimation results

As discussed in the previous section, a reverse causality relationship may exist between information asymmetry and disclosure, and lead to an inconsistent OLS estimator. The Hausman (1978) test is therefore introduced to check for this possible endogenous problem. Using Governance as the instrumental variable, the Hausman (1978) test results (Table 4) indicate that the dependent variables are not affected by the endogenous effect. The OLS regression model is therefore used in the next analysis.

As the link between Internet-based disclosure and information asymmetry is analyzed for two different periods (three and six months), the empirical results are presented in two different tables (Tables 5 and 6). Both tables contain five models according to the measure of information asymmetry (Relative Spread, time-weighted quoted spreads, effective spreads, PIN and AdjPIN). Models 1 to 3 are developed using the variations of spread in relation to the Web disclosure, the turnover ratio, the stock return volatility, the ownership concentration and the price level. Models 4 and 5 are developed to refine the analysis by using PIN and Adjusted PIN as dependent variables.

We can observe that the coefficients of Score in the first three models are significantly negative at the 1% level. The results indicate that enhanced disclosure via the Internet reduces the level of spread which is in accordance with past research (Petersen & Plenborg, 2006). Compared with Spread, PIN and AdjPIN are more precise measures of information asymmetry because they exclude other effects, such as fixed costs, inventory effects or liquidity effects. According to previous research in market microstructure, PIN and AdjPIN can better capture information asymmetry. Results in Models 4 and 5 show that Web-based disclosure is negatively and significantly related to PIN and AdjPIN. This confirms our findings in Models 1 to 3. The effect of Internet-based disclosure on the spread is only due to information asymmetry. Therefore, Models 4 and 5 provide strong support for the
impact of Web-based disclosure on the reduction of information asymmetry. This result is proved whatever the period, either three or six months. Therefore, we validate our hypothesis.

Furthermore, we find that the Turnover coefficient is significantly negative in all the models. This is consistent with the theory that higher levels of trading volume will improve stock liquidity, therefore leading to a reduction of information asymmetry. We ran the VIF test to control the multicollinearity and the results show that no variance inflation factor values are greater than 1.8. We used the Breusch–Pagan test to control for the potential risk of heteroscedasticity; the results indicate that some models do not satisfy the constant variance assumption. We therefore ran the regression with robust standard errors to control for the heteroscedasticity problem; the results (which are not reported here) indicate that the negative relationship between Internet-based disclosure and information asymmetry are not affected by heteroscedasticity. Our empirical results are therefore robust.

Overall, these results are consistent with the specificities of the French institutional environment. France belongs to the category of code-law countries (by opposition to the category of common-law countries). Code-law countries such as France are characterized by high ownership concentration, a model of corporate governance that is less oriented towards the shareholders and with less information content of accounting information that is reinforced by less frequent disclosure. As a consequence, Web-based disclosure in code-law countries may play a greater role in reducing information asymmetry between managers and shareholders. Furthermore, our findings highlight the importance of the network technology in the reduction of information asymmetry.

### 6. Conclusion

Firm disclosure is one of the fundamental elements affecting the efficiency of the capital market (Healy & Palepu, 2001; Shaw, 2003). It is important for managers, investors and regulators to understand the interaction between information disclosure practices and information asymmetry. This paper focuses on online disclosure practices resulting from the rapid growth in the use of the Internet for financial reporting (Bollen, Hassink, & Bozic, 2006; Marston & Polei, 2004). The main objective is to analyze how the use of the Internet for disclosure affects information asymmetry in the capital market.

As an extension of previous research, an index consisting of 40 items is developed in order to assess the information released via the Internet in France. Based on a sample of 180 French listed companies belonging to the SBF 250 index, we observe a strong negative relationship between Internet disclosure and the level of information asymmetry. These findings are consistent with research carried out in other countries, and the characteristics of the French institutional environment. The empirical findings suggest that it is important for the French quoted companies to increase information transparency in order to reduce information asymmetry and improve investor relations.

The relationship between financial disclosure and information asymmetry is a classic subject and has been studied in prior research by examining traditional paper-based media such as annual reports. One might ask whether it is necessary to retest this relationship by analyzing the information spread via the Internet. Indeed, the Internet could be treated as an information media, along with other traditional paper-based media. However, certain special features of Internet-
based disclosure highlight the necessity to retest the impact of this media. Internet technologies can gather a huge amount of information and this far exceeds traditional paper-based media. Another consequence is that rumors circulate fast online. Internet-based disclosure can still effectively reduce the problem of information asymmetry. Although there are some potential drawbacks, Internet-based disclosure can still effectively reduce the problem of information asymmetry. More importantly, our results show that Internet technologies have greatly enriched information presentation methods, and these user-friendly Web technologies, such as financial reports in Excel format, are useful to reduce the information gap. These findings emphasize the need for the normalization of Web disclosure in both content and presentation perceptions.

This research is not without limitations. The negative effects of financial reporting, such as losing an advantage in a competitive market, are not considered in our research. Furthermore, the research only examines certain factors that may influence information asymmetry. Other new factors, such as the role of financial analysts, should be introduced into future research. Lastly, as firms are generally motivated to lower their cost of capital, it would be interesting to determine whether the impact of Web disclosure on information asymmetry helps the firm to benefit from a lower cost of capital over the long term.

Appendix A. Summary of regulated information in the French capital market

The AMF press release of January 22, 2007, summarized the following documents, which are listed in article 221-1 of the AMF’s General Regulations, as “regulated information”:

- The annual financial report;
- The half-yearly financial report;
- The quarterly financial disclosure;
- The report on internal control procedures and reports from independent auditors on the aforementioned reports;
- The news release concerning fees paid to independent auditors;

Table 5
Regression results for the 3 month study period.

<table>
<thead>
<tr>
<th></th>
<th>Dependent variables</th>
</tr>
</thead>
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<tr>
<td></td>
<td>R_Spread</td>
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<tr>
<td></td>
<td>Coef. t</td>
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<tr>
<td>Score</td>
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<td>Turnover</td>
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<td>R²</td>
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<td>Adj R²</td>
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<td>sig</td>
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</table>

Note: The number of observations is equal to 180.
Score is the level of Internet-based disclosure; R_Spread is the average quoted spread; W_Spread is the time-weighted average quoted spread; E_Spread is the average effective spread; PIN is the probability of informed trading defined by Easley et al. (1996); AdjPIN is the adjusted PIN developed by Duarte and Young (2009); Turnover is the turnover rate of stocks; Volatility is measured by the standard deviation of daily stock returns; LnPrice is the stock price measured in logarithm; Bloc represents the proportion of capital held by blockholders (those owning 5% or more of a firm’s stock).

⁎ Indicates significance at the 10% level.
⁎⁎ Indicates significance at the 5% level.
⁎⁎⁎ Indicates significance at the 1% level.

Table 6
Regression results for the 6 month study period.

<table>
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Note: The number of observations is equal to 180.
Score is the level of Internet-based disclosure; R_Spread is the average quoted spread; W_Spread is the time-weighted average quoted spread; E_Spread is the average effective spread; PIN is the probability of informed trading defined by Easley et al. (1996); AdjPIN is the adjusted PIN developed by Duarte and Young (2009); Turnover is the turnover rate of stocks; Volatility is measured by the standard deviation of daily stock returns; LnPrice is the stock price measured in logarithm; Bloc represents the proportion of capital held by blockholders (those owning 5% or more of a firm’s stock).

⁎ Indicates significance at the 10% level.
⁎⁎ Indicates significance at the 5% level.
⁎⁎⁎ Indicates significance at the 1% level.

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Appendix B. Internet-based disclosure index

<table>
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<tr>
<th>N</th>
<th>Index</th>
<th>Overlap with prior research</th>
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<tr>
<td>1</td>
<td>Current share price</td>
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<tr>
<td>2</td>
<td>Press releases</td>
<td>a, b, c, d, e</td>
</tr>
<tr>
<td>3</td>
<td>Annual report – interactive version</td>
<td>a, b, c, e</td>
</tr>
<tr>
<td>4</td>
<td>Internal search engine</td>
<td>a, b, c</td>
</tr>
<tr>
<td>5</td>
<td>Investor relations e-mail address</td>
<td>a, b, c, e</td>
</tr>
<tr>
<td>6</td>
<td>Newsletters/mailing list</td>
<td>a, b, c</td>
</tr>
<tr>
<td>7</td>
<td>Annual report in pdf format</td>
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<tr>
<td>8</td>
<td>Frequently asked questions (FAQs)</td>
<td>a, d</td>
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<td>Financial report in Excel format</td>
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</tr>
<tr>
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<td>Monthly information releases</td>
<td>b, c, e</td>
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<td>Comparison with benchmark indices (CAC40/SBF120/SBF250)</td>
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<td>26</td>
<td>Flash</td>
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<td>27</td>
<td>Grouping of AMF-regulated financial information</td>
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References


