

A Study on the Measurement of Voluntary Disclosure Quality Using Real-Time Disclosure By Programming Technology

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Abstract

This study focuses on presenting the IT program module provided by real - time forecasting and database of the voluntary disclosure quality measure in order to solve the problem of capital cost due to information asymmetry of external investors and corporate executives. This study suggests a model of the algorithm that the quality of real - time voluntary disclosure can be provided to all investors immediately by IT program in order to deliver the meaningful value in the domestic capital market. This is a method of generating and analyzing real-time or non-real-time prediction models by transferring the predicted estimates delivered to the Big Data Log Analysis System through the statistical DB to the statistical forecasting engine.

***Keywords:** voluntary disclosure quality, disclosure window, standardized analyst forecast dispersion, standardized analyst mean forecast error squared*

1. Introduction

While corporate executives have more internal information about the status and business prospects of firms than external investors, external investors who do not know the internal information undervalue the superior companies and overvalue the bad companies[1], which is the so-called 'lemons problem'. Therefore, external investors are willing to buy stocks or bonds at lower prices to make up for the expected loss of information asymmetry[2]. As a result, the cost of capital rises and profitable investment opportunities can be rejected, leading to superior executives having the incentive to increase the quality of disclosure and actively communicate true corporate values to the outside[3,4]. In this way, if the firm discloses sufficient and timely information in a timely manner, the cost of capital will be further reduced. In the end, higher quality of disclosure by a superior company may serve as a useful means of preventing an increase in capital cost. However, Since there are various paths and methods, for example, corporate disclosure is conducted in the form of non-disclosure and management forecasting through financial statements, corporate analysts' meetings, conference calls, press conferences, internet sites, and other corporate reports. And disclosures carried out through information intermediaries (such as financial analysts, industry literatures, and economic newspapers), quantifying the quality of disclosure is a real limitation.

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There are three general measures of Disclosure Quality that are widely known in overseas studies. The first is the AIMR score. The Association for Investment Management and Research(AIMR) is a financial analysts rating of each company's disclosure level based on annual reports, timely reports, and investment briefings. However, the AIMR score is the possibility of subjective bias by the evaluator, and the publication of the AIMR score has been discontinued since 1997. In addition, since the data are derived from US companies, they can not be used for research on domestic companies. Secondly, there are multiple evaluations of the operating environment, historical performance summary, major financial ratios, management forecasts and management discussions in the annual report[5]. However, it is qualitatively superior to the results obtained by precise analysis. However, the analytical sample may be limited because it takes a lot of time and money to analyze it, and there is a high possibility that the subject of the evaluator will intervene because there is no objective evaluation criterion. Third, we conducted a factor analysis on the variables (institutional investor, buy-sell price difference, follow-up financial analyst number, etc.) that had a significant effect on the quality of disclosure through previous studies. However, since these measures are mainly measured using involuntary disclosure factors, it is likely that there will be certain limitations in measuring the quality of voluntary disclosure involving management discretion.

We focused on the active disclosure of information by managers at the time of maximizing the information capacity of the annual accounts settlement (from the period immediately after the disclosure of the third quarter until the disclosure of the annual disclosure). Financial analysts will immediately reflect this information in earnings forecasts due to their nature as an information mediator with incentives to increase the accuracy of earnings forecasts. In addition, if the level of disclosure is clear but incorrect, the consensus among investors increases, but the accuracy of investors' forecasts decreases. In order to accurately measure the net effect of disclosure, it is necessary to consider both sides of change such as changes in consensus or accuracy will be. Zhang(2005) also considers changes in the financial analyst profit forecast dispersion (proxy of investor consensus) and profit-side error square (proxy of investor prediction accuracy) together after establishing the manager's highest information ability during the year And the quality of voluntary disclosure was measured[6]. Zhang(2005) 's disclosure quality measure is different from the previous report' s disclosure quality measure in that it is measured after considering both the investor consensus and the accuracy change of the investor forecast.

This study suggests the implications of the Measure of Voluntary Disclosure Quality of Zhang(2005) and suggests measures and disclosures in real - time IT programs. If the voluntary disclosure quality measure is stored as a statistical DB and the measurement values generated by the statistical algorithms of the IT program are immediately provided to all investors, the timeliness of information is improved and the information asymmetry between investors This study is expected to contribute to the resolution.

Financial analysts' forecasting information is superior to general investors and at the same time, it has excellent information analysis capability. Therefore, the more accurate information is provided to the financial analysts through conference calls, the more accurate the earnings forecast of financial analysts of related companies. Financial analysts mainly rely on accounting information published by firms when estimating profits[7], the accounting information disclosed by the firm will affect the analysts' profit forecasts and the economic decisions of external investors[8]. In the end, how well the information intermediaries, which are financial analysts, interpret and transmit real-time information provided by the enterprise is the key factor that resolves the information asymmetry problem between the company and external investors. Therefore, it is expected that the IT programming module proposed in this study will be an optimal module for solving this information asymmetry problem by measuring real-time quality of

voluntary disclosure of companies and delivering them to external investors in real time. In addition, this study is expected to be a starting point for the follow-up study for the introduction and realization of related IT technology to implement the module.

This study is composed as follows. Introduction. Purpose of prior studies and research. The Definition of Zhang's Qualitative Measure. Automatic Estimation and Real-time Disclosure by Programming Technology. Finally, the conclusions and limitations of this study are discussed.

2. Prior Researches and The Purpose of This Paper

Theoretically, rational firms will choose for full voluntary disclosures to reduce information asymmetry and cost of capital[3,9,10]. Many of related articles show that A firm's disclosure reduces information asymmetry, improves its stock liquidity, and therefore lowers cost of capital for the firm[11]. Overall, evidence from the empirical disclosure literature supports the theoretical predictions that voluntary disclosure reduces information asymmetry, improves stock liquidity, and lowers cost of capital for disclosing firms.

But these theoretical conclusions are inconsistent with empirical observations that managers exercise discretion over their disclosure choices. The reason is that the firm's manager has to choose its disclosure level to maximize its capital market valuation taking into consideration the proprietary cost[11]. Briefly, disclosure decisions are results of managers' tradeoff between costs and benefits associated with disclosures choices, especially the proprietary cost.

A unique partial disclosure equilibrium obtains wherein the disclosure threshold is the level at which the benefits from disclosing the private information justify the proprietary cost and as a result only favorable information is disclosed. It is shown that full disclosure never exists as long as the proprietary cost is positive and that the disclosure threshold increases with the proprietary cost. There are so many empirical evidences related to these theoretical demonstrations. Darrough and Stoughton(1990) demonstrate a partial disclosure equilibrium in which favorable information is never disclosed[12] (to deter the opponent's entry into the product market) but unfavorable information is disclosed sometimes. Feltham and Xie(1992) derives a somewhat different partial disclosure equilibrium that consists of two non-disclosure intervals – the most unfavorable information (to avoid negative market reaction) and the most favorable information (to avoid proprietary cost arising from the opponent's entry)[13]. Newman and Sansing(1993) conclude that disclosure decisions of a manager who wishes to communicate favorable information to its investors but unfavorable information to its strategic opponent (the entrant) to avoid proprietary cost[14]. Gigler(1994) shows that disclosure decisions of a manager who is motivated to increase the current price of the firm's stock in a duopoly product market[15]. The researcher also conclude that the manager can achieve higher current market valuation of the firm by overstating its future profitability because the existence of proprietary cost makes the disclosures credible to the investors. Thus, when managers are allowed discretion over disclosure content, these studies demonstrate that manager's discretion affects the precision and accuracy, i.e., quality, of firms' voluntary disclosures.

Existing empirical research also provides some evidence on the role of proprietary cost in corporate discretionary disclosure decisions, where disclosure is measured using various proxies. A substantial amount of empirical disclosure research focuses on management earnings forecast and preannouncement behavior. However, this research has not provided consistent evidence with respect to the determinants of management forecast decisions. Examining management earnings forecast behavior alone may be inadequate for addressing the most fundamental issue of disclosure decisions. Managerial disclosures cover the full spectrum of operating information such as earnings forecasts, new product developments, and dividend

information as well as non-operating information such as appointments of officers and board members. Thus, the results from earnings forecast studies may not generalize to firm's overall disclosure behavior. Fewer studies have examined firms' comprehensive disclosure behavior, mainly due to the lack of a reliable theoretical framework and the difficulty of measuring comprehensive corporate disclosures. Studies using analyst ratings of disclosures or author-constructed disclosure measures provide useful evidence on the firms' overall disclosure practices beyond management earnings forecast activities. However, both analyst ratings and author-created metrics are subject to bias that might be brought in by the agents who create the data.

An increase in either the quantity or the quality of public information reduces the risk of the asset to the public investors and therefore reduces the equilibrium required returns to holding the asset[16]. As long as there exists private information, uninformed public investors are always disadvantaged relative to privately informed investors and public investors cannot fully infer the content of the private information from the assets' equilibrium price. They also provide a rationale for how a firm can influence its cost of capital by choosing the quantity and quality of its public disclosures. Knowing a firm's choices of the quantity and quality of disclosures affect its cost of capital. By the way, the firm's choices of the quantity of disclosures can credibly be measured, even not the quality. In other words, some firms periodically issue earnings forecasts while others do not; some firms issue point estimate earnings forecasts while others only make qualitative statements. This mean that public(uninformed) investors should be freely supplied with qualitative information for fair games related to the investments. In this paper, I intend to offer a production mechanism of the qualitative measure that reliably and automatically will be made for the fair game, either uninformed or informed investors.

Zhang(2005) define quality as the precision and accuracy of information, reflected by the extent to which the disclosed information narrows the dispersion of investors' beliefs and reduces the bias in investors' expectations, assuming that investor's expectations are conventionally proxied by analyst forecasts of annual earnings per share[6]. First of all, I demonstrate that zhang's qualitative measure may be useful as information for the fair investments. Finally, I will roughly show the mechanism how zhang's qualitative measure is automatically produced.

3. The Definition of Zhang's Qualitative Measure

3.1 The Disclosure Window

The disclosure window have a period of the approximately 100 days that commence on the third day following a firm's third quarter earnings announcements and end one day prior to the annual earnings announcements. The fiscal year is the principal reporting period and quarterly reports are essential parts of the annual financial reporting process. Managers are permitted to use managerial estimates of certain expenses such as income tax expenses more extensively in quarterly reports than in annual reports. As a corporate nears fiscal year end, managers are required to make adjustments to interim estimates in order to prepare annual filings that are investigated by audit firm. It is logical to expect that managers get a more explicit picture about the upcoming management performance of the fiscal year end draws close and therefore they can more easily guide the capital market expectations such as involved analysts that they want to do so. Thus, I infer that firms have more information available to disclose during the defined disclosure windows.

3.2 Estimation of the Zhang's Qualitative Measure

Zhang's Quality refers to the precision and accuracy of disclosures, measured by the increase in consensus and accuracy of investors' expectations over the disclosure window. As prior research use analyst

forecasts as proxies for investors' expectations, consensus is the inverse of analyst forecast dispersion (variance) and accuracy is the inverse of mean analyst forecast errors squared. There is empirical evidence of a negative relation between the extent of firms' disclosure of their accounting policies and their analyst forecast dispersion[17]. Analyst forecasts issued after management forecasts are more accurate than analyst forecasts issued prior to management forecasts but are no more accurate than the management forecasts, suggesting that analyst forecast accuracy is bounded by management forecast accuracy[18]. Taken together, theory and empirical research has established the link between information quality and consensus and accuracy of investor beliefs. Zhang use the consensus and accuracy effects of disclosures on the investors' beliefs to proxy for the quality of disclosures. Since disclosures are likely to affect dispersion (consensus) and forecast errors (accuracy) simultaneously, the two effects may be in the same or opposite directions. In cases where the two effects are in different directions, it may become difficult to conclude whether the new disclosure leaves public investors better informed if we examine the dispersion changes or forecast error changes in isolation. To account for both effects at once, and to facilitate cross-sectional comparisons of disclosure quality, Zhang standardize both forecast dispersion and mean forecast errors squared (to mean = 0 and standard deviation =1) and use the sum of the standardized values as a composite measure of dispersion and forecast error. The complexed measure is computed at both the beginning and the end of the disclosure window. To capture the effects of the disclosures made during the specified disclosure window, Zhang take the change in the complexed measure from the beginning to the end of the disclosure window to be my measure of disclosure quality. Since a positive change in the complexed measure implies poor quality, zhang multiply this measure by negative one so it becomes an increasing function of precision and accuracy. Zhang label this variable QUALITY. It is then linearly residualized with respect to the beginning level of complexed measure to partition out the portion of changes in complexed measure. Thus, the residualized QUALITY is comparable across firms. Beginning level of complexed measure is calculated using at least two distinct analysts' annual EPS forecasts issued within 30 days immediately following the third quarter earnings announcements. Ending level of complexed measure is calculated using at least two distinct analysts' annual EPS forecasts issued over the 45 days commencing on the 61st day after the third earnings announcements but prior to the annual earning announcements. Zhang use a longer window for the ending complexed measure calculations because fewer analysts issue forecasts preceding annual earnings announcements than immediately following third quarter earnings announcements.

4. Automatic Estimation and Real-time Disclosure By Programming Technology

The process of deriving the Measure of Voluntary Disclosure Quality in this study is summarized as Figure 1. The complexed measure[COMBO(0)] of the Disclosure Window Starting Point(0) is calculated using the financial analysts' Annual Earnings Per Share(hereinafter, EPS) (2 or more samples) forecast within 30 days immediately after the disclosure of the third-quarter earnings. The complexed measure[COMBO(1)] of the Disclosure Window Ending Point(1) is calculated using the financial analyst's EPS(2 or more samples) forecast for 45 days commencing on the 61st day after the third quarter earnings announcement.

The COMBO(complexed measure) is the sum of the standardized Analyst Profit Forecast Dispersion(variance) and the standardized Analyst mean Forecast Error squared. And the change value(Δ COMBO) of the complexed measure is calculated as the difference between the COMBO value of the Ending Point(1) and the Starting Point(0), and this value becomes measure of voluntary disclosure quality(QUALITY).

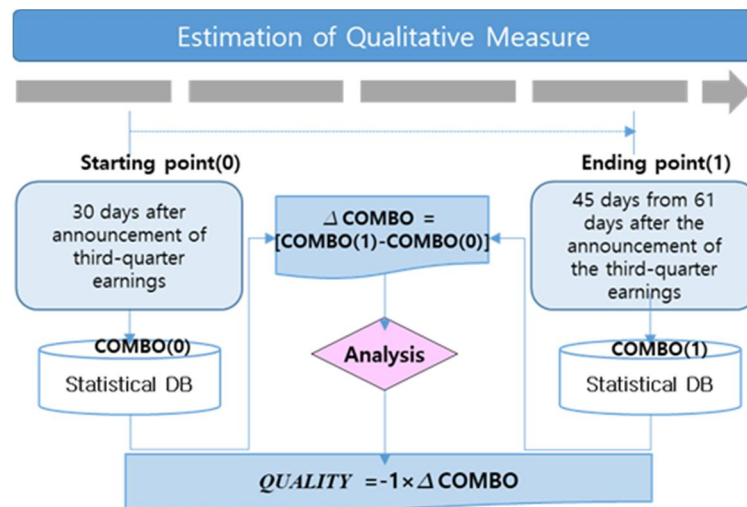


Figure 1. Framework for Estimation (QUALITY)

If the change value (ΔCOMBO) of the complexed measure devised by Zhang(2005) is converted to voluntary disclosure quality in real-time by IT programming and immediately provided to all investors, the timeliness of information is improved. It is expected that the problem of asymmetry of information among investors will be solved at the relevant level.

This study presents an outline of the algorithm of real-time conversion by IT programming in Figure 2. According to Kdnuggets(www.kdnuggets.com), the most commonly used tool for data analysis in 2015 is 'R'. 'R' started with version 1.0 in 2000 under the leadership of Professor Rothschka and Robert Gentleman, professor at the University of Auckland, New Zealand. Since 'R' is applied to real-time log analysis system, the module size is too large and separate program ability is needed. Therefore, only the most used algorithms are selected in this research for light weight and easy to use. As shown in Figure 2, the statistical prediction engine is designed based on a mathematical standard library. The statistical prediction engine is integrated with the log analysis system, and is a model that performs prediction based on the values stored in the statistical database rather than the direct prediction using the original log.

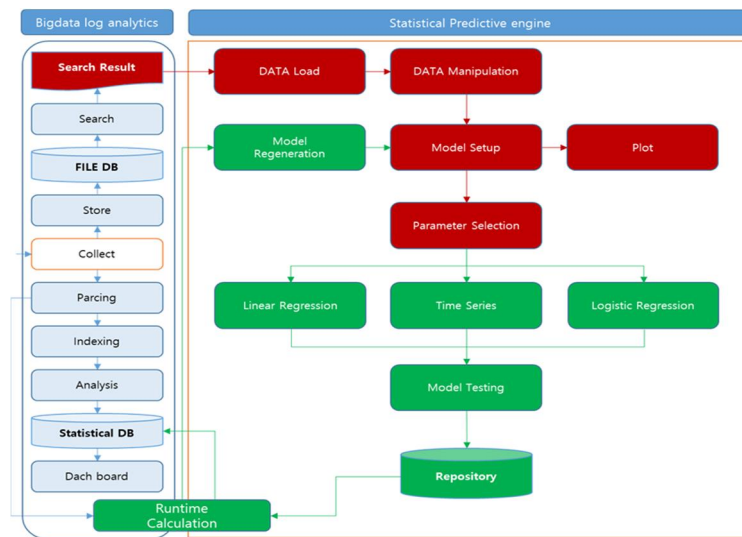


Figure 2. Detailed module configuration

First, the predictive analysis via the 'statistical DB' is transmitted to the big data log analysis system through the statistical DB together with the results of the predictive analysis by searching & extracting the big data original log. 'Runtime Calculation' is the most important factor in real-time forecasting analysis. It calculates predicted estimates for all logs in real-time using a prediction model generated from big data log and returns the result. The 'Data Load' extracts the log from the repository of the Big Data Log Analysis System and transfers it to the statistical forecasting engine. The statistical forecasting engine generates and analyzes the predictive model using the log. The statistical prediction engine operates in a batch mode. The predicted model is generated by extracting the necessary data from the original log stored in the big data log analysis system. The generated model is calculated using the 'Runtime Calculation' module And perform periodic non real-time analysis together. Statistics and prediction algorithms use the most commonly used Linear Regression, Time Series and Logistic Regression. Linear regression analysis is a method of analyzing whether there is a causal relationship between two or more variables and if so, how much of each variable affects the proportion. It can be used for predicting the causal factor if the causal factor can be predicted, or it can be used for outlier judgment and outlier detection for the current collection value rather than prediction in the real-time analysis environment. Time series analysis is an analysis that grasps the characteristics of data and predicts future values based on the data observed over time. Logistic regression analysis is an analytical method used when the value to be estimated is dichotomous, such as True / False. Regression analysis is mainly used for analyzing and predicting continuous data.

Prior researches have shown that financial analysts' forecasting information is superior to forecasting information based on the time series models based on the random-walk model[19]. It is considered that the superiority of the financial analyst forecasting information is due to the fact that financial analysts are superior to other general investors in terms of information acquisition status and at the same time have excellent information analysis ability. In particular, as more information is provided to financial analysts through conference calls, the analysts' earnings forecasts are more accurate. Financial analysts mainly rely on accounting information disclosed by companies when predicting profit[4]. In other words, the accounting information disclosed by the firm affects the profit forecast of the financial analyst and the profit forecast of the financial analyst influences the economic decision of the external investor[8]. Finally, how well the information intermediaries, which are financial analysts, interpret and transmit real-time information

provided by the enterprise is the key-factor that resolves the information asymmetry problem between the company and external investors. Therefore, it is expected that the IT programming module proposed(Figure 2.) in this study will be an optimal module for solving this information asymmetry problem by real-time measure of voluntary disclosure quality of the company and delivering it to external investors in real time. In addition, this study is expected to be a starting point for the follow-up study for the introduction and realization of related IT technology to implement the module[20].

5. Conclusion

External investors, who are not familiar with internal information within the company, can solve the problem of capital cost caused by information asymmetry with high disclosure quality, the quality of disclosure is difficult to quantify or measure based on its attributes. Although previous studies have presented the quality measure of three types of disclosure, they have inherent limitations that are difficult to apply to Korean firms.

This study presents a model for measuring the disclosure quality of Zhang(2005), which can be applied to domestic business phenomena. He sets up a disclosure window that is the period during which managers maximize the ability to guide the market, in this period, the quality of disclosure was measured by using analysts' profit Forecast Dispersion(variance) and profit Forecast Error squared. The quality measure of disclosure is an appropriate measure for the decision-making decision of the disclosure type that is determined by management's discretion. In addition, the quality of the disclosure of Zhang(2005), which has various advantages compared with the voluntary disclosure quality measure of the previous research, is converted into the quality data of real-time voluntary disclosure by the IT program, and an outline of the algorithm that can be immediately provided to all investors is presented. As a data analysis tool of IT programming, 'R' is used and only the most used algorithms are selected so that the statistical prediction engine can be designed based on a mathematical standard library. Through the statistical database, the predicted values delivered to the Big Data Log Analysis System are transferred to the statistical forecasting engine to generate and analyze real-time or non-real-time forecasting models.

It is significant that the quality of voluntary disclosure proposed by this study is measured and predicted by real-time IT program module and delivered to external investors in real - time to solve information asymmetry problem. Disclosures are very difficult to quantify because they are performed in nature or in a variety of ways. The quality measure of voluntary disclosures designed by Zhang(2005) sets the highest level of information capability of managers during the year, this is different from the previous studies in that it was measured at the same time considering changes in the accuracy of investor consensus and investor forecasts. In addition, it is expected that the ability to accurately predict real-time information by presenting statistical algorithms of IT programs can contribute to resolution of information asymmetry.

In order to accurately measure the quality of voluntary disclosures, the limitation of this study is to derive a comprehensive evaluation from the disclosure policy of the company to the entire disclosures conducted by the company, the results of this study are based on the analysts' earnings forecasts, which indirectly indicate the quality of disclosure. Also, since the specific IT technology for implementing the proposed module is not specified in this study, it is expected that the content will be the starting point of the follow-up study.

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