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Securities Market Quality and Analysts' Earnings Forecast Errors

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Abstract: This study investigated the influence of securities market quality on analysts' earnings forecast errors. Companies listed on the Taiwan Stock Exchange (TWSE) between 2009 and 2011 were used as the research sample. The empirical results indicated that with rising securities market trading quality, analysts' earnings forecast errors reduced significantly. This suggested that a low information asymmetry signifies an increase in the accuracy of analysts' earnings forecasts. In addition, when trading quality in the securities market increases, the volatility of analysts' forecast error decreases and the perspectives of securities market analysts on the future of a single share gradually converge. The empirical results obtained in this study can provide competent authorities with a reference for increasing securities market trading quality which assists securities market analysts in forecasting accurate earnings.

Key words: Analyst forecast error, market quality, information asymmetry

INTRODUCTION

With the increasing scale of securities markets, investors can acquire, digest and absorb numerous data available in the market, however, most investors lack time, skills, information sources and the ability to interpret financial statements. Currently, analysts are accounting information users and providers (Schipper, 1991). Because analysts possess professional knowledge, information and time advantages (Kross *et al*., 1990), their abilities can compensate for those lacking in inexperienced investors (Beaver, 2002), thereby providing investors with systematic and accurate information. Securities market analysts act as intermediaries between companies and external investors and investors typically consider the most current financial forecasts provided by analysts as crucial investment references (Stickel, 1992; Beaver, 2002; Bonner *et al*., 2003; Clement and Tse, 2003). However, Woolridge (2004) indicated that over time, when investors engage in market trading operations based on analyst forecasts, their return on investment does not surpass market returns. Because of forecasting accuracy and other factors, analysts intentionally or unintentionally produce earnings forecast errors which may mislead investors. Therefore, investors typically consider and make decisions based on analysts' earnings forecasts, thus, errors directly affect the success of securities stock investment decisions.

Previous literature has discussed the reasons causing the generation of analysts' forecast errors which can be summarized from three perspectives. First, analysis can be performed from the perspective of corporate governance (Beasley, 1996; Fan and Wong, 2002) to review information transparency issues. Motivated by self-interests, management authorities withhold specific information from the public which results in information asymmetry and misleads people's evaluations of companies. Analysts cannot judge the personal integrity of employees which substantially distorts their earnings forecasts. Second, studies have analyzed corporate earnings management behavior and the authenticity of financial statements from the perspective of earnings management (Payne and Robb, 2000; Abarbanell and Lehavy, 2003). Managers window dress corporate financial statements to consolidate their own positions, thereby manipulating their earnings in the financial statement which mislead the public regarding corporate prospects. Thus, information asymmetry in financial statements causes analysts to distrust financial reports. Consequently, this increases the difficulty of forecasting earnings and results in forecast errors. Finally, from the perspective of audit quality (Francis *et al*., 2005), studies have discussed audit and accounting report quality issues. Audit quality directly affects the credibility of financial statements. High financial statement credibility reduces information asymmetry and thus lowers earnings forecast errors.

Corporate governance, earnings management and audit quality all cause securities market information asymmetry. Therefore, according to the financial

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information asymmetry theory proposed by Akerlof (1970), this study identified the most representative variables of information asymmetry between investors and companies and elucidated that analysts' forecast errors typically result from information asymmetry existing in securities market. Compared with external investors, company managers have superior information about company operations and future development, however, based on their personal interests, managers provide only mandated information to external investors. Therefore, investors cannot obtain all corporate information. Thus, establishing a comprehensive mechanism for disclosing market information is vital because undisclosed financial and non-financial information reflects the status of future corporate development. This study hypothesized that the amount of undisclosed information influences analysts' forecast accuracy. In other words, a large amount of withheld information raises the uncertainty concerning future corporate development which subsequently increases earnings forecast errors.

This study asserts that information asymmetry is the primary factor generating analysts' forecast error. Because of information asymmetry, concealed information increases, thus elevating uncertainty in earnings forecasts. This study adopted the concept of information transparency of Lang and Lundholm (1996) to assess information asymmetry levels based on securities market trading quality and conduct forecast error related analyses. The results showed that market information asymmetry influences analysts' earnings forecasts and generates errors in earnings forecast.

In addition, market trading quality was used to examine the uncertainty in earnings forecasts that is caused by market information asymmetry. Thus, when market information asymmetry is low, low amount of undisclosed corporate information enables analysts to obtain identical information which decreases the level of disagreement in earnings forecasts and diminishes earnings forecast error volatility (Han and Manry, 2000). Conversely, when information is inadequate, information asymmetry rises, obtaining undisclosed information becomes difficult and analysts' earnings forecasts diverge, thereby increasing earnings forecast error volatility. This study inferred that high information asymmetry level increases market uncertainty and expands the volatility of analysts' earnings forecast error. This study was based on analyst 2009-2011 forecast data of all the listed companies on the Taiwan Stock Exchange (TWSE). Study samples were the intraday data on trading quality and seasonal data on analysts' forecasts obtained from the database of the Taiwan Economic Journal (TEJ). Statistical methods, including regression analysis, were employed to investigate the correlations between analysts' forecast errors and market trading quality. The results showed that analysts' forecast error is affected by market trading quality. Consequently, we used market trading quality indicators (i.e., spread, market depth and volatility) to assess the level of market information disclosure (Gemmill, 1996; Boehmer *et al*., 2005; Madhavan *et al*., 2005). This study expects to achieve the following outcome: High market quality (i.e., small spread, increased depth and low volatility) lowers market information asymmetry, analysts' forecast errors and earnings forecast error volatility.

The study contributions were as follows. (a) We verified that securities market trading quality significantly influences analysts' forecast error. The level of information asymmetry affects future uncertainty in the securities market and thereby influences the accuracy of analysts' earnings forecasts. The investors can use these results as a reference when making investment decisions; (b) The empirical results demonstrated that securities market trading quality influences analysts' forecast error. Therefore, by considering the variations in securities market trading quality, analysts can revise their forecasts immediately to appropriately reflect the actual corporate situation and increase earnings forecast accuracy and (c) In addition, securities market trading quality reflects the level of market information asymmetry. Thus, the results can be used to attract the attention of competent authorities to the information disclosure mechanisms in the securities market and encourage them to provide an effective information disclosure environment which facilitates the reduction of market information asymmetry and activation of market trading.

HYPOTHESES DEVELOPMENT

Previous studies on analysts' forecast error have focused on financial statement quality. Jensen and Meckling (1976) connected information disclosure behaviors with corporate governance mechanisms and regarded information disclosure as a crucial factor in corporate governance mechanisms. Leftwich *et al*. (1981) indicated that a complementary relationship existed between corporate governance mechanisms and information disclosure quality: Corporate governance improves the information disclosure quality and strict monitoring mechanisms inhibit managerial self-interest behaviors, thus reducing information asymmetry. Lang *et al*. (2004) stated that stockholders in companies with weak corporate governance mechanisms were motivated to conceal and manipulate information, causing increased analyst forecast errors. Carcello *et al*. (2002)

indicated that the professionalism of independent directors could be defined according to quantitative descriptions. Holders of multiple independent director positions seek high-quality auditors to serve as gatekeepers of corporate financial statements to protect their personal reputations and interests. Schipper (1989) divided earnings managements into Accrual Earnings Management (AEM) and Real Earnings Management (REM). Wang and D'Souza (2006) considered AEM a type of window dressing activity. Roychowdhury (2006) defined REM as the manipulation of actual activities on financial statements to encourage investors to believe that companies had achieved their earnings goals. Both earnings management types result in analyst forecast error. Healy and Wahlen (1999) indicated that when managers practice earnings management, the corporate financial structure and financial statement accuracy are affected and stockholders and potential investors are misled. Therefore, practicing corporate earnings management is aimed at distorting investors' decisions and analysts' earnings forecast. When companies frequently conduct earnings management, the accuracy of analyst forecasts are damaged (Roychowdhury, 2006; Wilson and Wu, 2011; Jason and Marla, 2013). Behn *et al.* (2008) proposed the concept that the predictability of the audit quality and the accounting earnings was correlated to analysts' earnings forecast, because of the positive relationship between audit and financial statement quality. Almutairi *et al.* (2009) found that account tenure was positively correlated to the bid-ask spread which indicated that information asymmetry was positively correlated with audit quality. Based on these studies, we concluded that lengthy accountant tenures and audit periods restricted auditor independence and reduced audit quality. Zhou (2007) observed that companies who alternated between various auditors exhibited reduced information asymmetry. Anglin *et al.* (2011) found that experienced board of director members and highly professional audit committee members facilitated a reduction in information asymmetry.

Based on previous forecast error studies, analysts first consider financial statement information. However, the effect that the mentioned three confounding factors have on financial information causes analysts to question the accuracy of the information. In addition, the industrial information provided on financial statements is required by analysts to make forecasts and forecast errors are influenced by uncertainties existing in the future economic environment. Therefore, reducing information asymmetry in the securities market can effectively diminish forecast uncertainties and errors (Parkash *et al.*, 1995). The quality of market information disclosure influences forecast accuracy. Byard and Shaw (2003) indicated that increasing information disclosure quality not only reduces analysts' forecast errors but also raises forecast accuracy significantly. Ho *et al.* (1995) and Hope (2003a) all reached similar conclusions: A low information asymmetry level reduces forecast uncertainties and forecast error, thereby increasing forecast accuracy.

In studies regarding information asymmetry, Boehmer *et al.* (2005) indicated that the introduction of OpenBook service by the New York Stock Exchange (NYSE) enhanced studies and discussions on market transparency, because information related to limit orders can be obtained from traders' order books. They found that increased market transparency influenced investors' trading strategies and enhanced market quality. Moreover, Madhavan *et al.* (2005) used data obtained from the Toronto Stock Exchange and found that the introduction of automated trading systems in the securities market changed market quality. They asserted that using spread, depth and volatility obtained from limit order books facilitates evaluating the quality of securities market and determining market transparency.

Securities market quality and information asymmetry have typically been evaluated according to spread, market depth and price volatility (Ranaldo, 2004). The securities market quality proposed by Ranaldo (2004) was used to evaluate information asymmetry. In addition, this study divided the evaluation criteria according to three indicators: Spread, depth and volatility which are typically updated throughout the day. The reliability and timeliness of the resulting data are higher than that of general financial statements, thus, the data substantially reflect market fluctuations. Therefore, these indicators are suitable for evaluating information asymmetry levels in the securities market.

Because information asymmetry affects forecast error, when information asymmetry is low, analyst uncertainty and forecast errors decrease. This study referenced Ranaldo (2004) and used spread, market depth and price volatility to evaluate information asymmetry. High securities market quality indicates a high level of information disclosure (transparency), a low information asymmetry level and few forecast errors. Gemmill (1996) claimed that the differences between information asymmetry and the bid-ask spread were primarily caused by information transparency. Bessembinder (2000) stated that a small tick size engenders a decrease in the quote midpoint and bid-ask spread, indicating that a negative relationship existed between the bid-ask spread and market transparency. Gibson *et al.* (2003), Boehmer *et al.* (2005) and Anand *et al.* (2009) supported this argument. Consequently, this study inferred that in securities market trading, because of information asymmetry, buyers and

sellers cannot obtain information about the maximum strike price of a product or stock. Thus, high information asymmetry increases spread, resulting in the increase of forecast errors.

Information transparency increases when companies increase their level of information disclosure, prompting investors to invest (Frankel *et al*., 2006) and activating the securities market. Bloomfield and O'Hara (1999), Madhavan *et al*. (2005) and Lescourret and Robert (2011) identified with this perspective. When market depth increases, this suggests that the corporate information disclosure level is high which increases the securities market quality and reduces information asymmetry, thereby eliciting trading behavior and lowering forecasting errors.

The level of market information disclosure fluctuates based on legislative revisions and price volatility varies because of the fluctuations in market quality (Madhavan *et al*., 2005). After evaluating NASDAQ data trends, Chung and Chuwonganant (2009) reported that when high transparency exists in the market, market trading becomes robust, thereby lowering price volatility. Comerton-Forde *et al*. (2011) claimed that less-popular securities markets attract people who possess control over internal information (i.e., informed traders). Short-term high volatility and large spread occur in these markets. Therefore, we postulated that price volatility represents price changes within a certain period. High price volatility indicates low level of market information disclosure, high information asymmetry and increased arbitrage practice which cause forecast errors to increase.

Based on the literature, we analyzed the relationship between securities market trading quality and forecast errors by formulating two hypotheses. The first hypothesis concerned analysts' earnings forecast error. This study evaluated the level of information asymmetry based on securities market trading quality and considered that when information asymmetry is low, the accuracy of analysts' forecasts increases. The first hypothesis was proposed as follows:

- **H1:** High securities market trading quality significantly reduces analysts' forecast errors which suggests that low market information asymmetry increases the accuracy of analysts' earnings forecast

The second hypothesis involved the volatility of analysts' earnings forecast error. Depending on their personal capabilities, analysts can acquire diverse information. Moreover, high levels of information asymmetry indicate that corporate managers are withholding considerable data; thus, information obtained among analysts diverges, causing the volatility in earnings forecasts to increase. Therefore, this study maintained that high securities market trading quality lowers analysts' forecast error volatility, indicating that most analysts in the securities market may reach the same conclusion regarding the future of shares. The second hypothesis was proposed as follows:

- **H2:** High securities market trading quality reduces analysts' forecast error volatility, suggesting that the perspectives of analysts on the future of shares are consistent

MATERIALS AND METHODS

Sample selection and data sources: This study presents a discussion on the influence of securities market quality on analysts' forecast errors. Data on analysts' forecasts and securities market quality were obtained from the TEJ and intraday trading database. Data regarding companies listed on the TWSE between 2009 and 2011 were analyzed, however, data from the finance and insurance industries and companies on which no forecasts were conducted were excluded because these industries have different regulations on how their financial statements are formulated. Based on previous studies of forecast errors, the analyzed data were typically a combination of seasonal and annual data on analysts' forecast. Unlike previous research, this study adopted the market microstructure concept, combining the variables relevant to securities market quality and analysts' forecast errors to understand whether forecast errors were influenced by securities market quality. However, data concerning market microstructure primarily involve using intraday data to investigate market quality; in addition, analysts' financial forecasts are typically based on seasonal or half-yearly data. Therefore, to facilitate analysts' forecasts and accommodate the uniqueness of securities market quality data, we converted the intraday data on securities market quality into daily data by averaging the data values. Consequently, this approach maintains the authenticity of the securities market quality data and retains the connection between the data on market quality and analysts' forecasts to preserve the data characteristics.

Definition of analysts' earnings forecast error: Data pertaining to analysts' forecasts on year-end Earnings per Share (EPS) were obtained from databases. We primarily investigated the factors that influenced forecast error and used analysts' forecast errors and volatility as the principal observation values to determine whether different results were generated according to market quality variations.

The analysts' forecast errors were obtained using two approaches. The first approach involves determining the absolute value by calculating the differences between analyst pre-event forecasts of the year-end EPS values and the actual EPS values (Parkash *et al*., 1995; Eng and Teo, 1999; Hope, 2003a, b). The absolute values were then used as sample values for discussing analysts' forecast errors.

The second method used for evaluating analysts' forecast error involves analyzing the analysts' year-end forecast values on the same companies. In other words, the samples regarding analysts' earnings forecast errors were (a) Year-end forecast values obtained by the analysts and (b) Differences among the overall average year-end forecast values obtained by the analysts.

Definition of analysts' earnings forecast error volatility: The volatility of analyst forecast errors represented the differences among company earnings forecasts of numerous analysts (Lang and Lundholm, 1996; Han and Manry, 2000). Differing levels of information disclosure caused information asymmetry which resulted in analysts possessing inconsistent company information, thereby yielding differences in earnings forecasts. This is referred to as the volatility of forecast errors.

Analyst forecast error volatility was assessed using two approaches. The first approach was evaluating the differences among analysts' year-end forecasts and the actual values and using the standard deviation to calculate the level of volatility. The second approach was using the differences between various analyst year-end forecasts and the average of all analyst forecasts on the same company, where the standard deviation was used to calculate the level of volatility.

Empirical model and variables: This study further extended the models proposed by Lang and Lundholm (1996) and Ranaldo (2004), adopting the Ordinary Least Squares (OLS) method to examine the relationship between market quality and analysts' forecast error. The regression model can be calculated as follows:

$$AFE_{i,t} = a_0+a_1\,Spreadit+a_2\,Depth\_Bit+a_3Depth\_Sit+a_4\,Volatilityit+a_5ROE_{it}+a_6Size_{it}+a_7Institution+a_8AGE_{it}+a_9\,Industry_{it}+a_{10}Board_{it}+\varepsilon_{it} \quad (1)$$

$AFE_{i,t}$: Forecast error which can be divided into actual value ($AFE_{i,t}\_R$) and the overall average value ($AFE_{i,t}\_A$):

$$AFEi,t\_R = \frac{|FEPS_{i,t} - AEPS_t|}{P_t}$$

$$AFEi,t\_A = \frac{|FEPS_{i,t} - AFEPS_t|}{P_t}$$

where, i represents the analyst code, t denotes time, $FEPS_{i,t}$ represents i analyst pre-event forecasts of the EPS at the end of t year, $AEPS_t$ denotes the actual EPS at the end of t year, $AFEPS_t$ represents the overall average EPS of analysts' forecast at the end of the t year and P_t is the share price at the beginning of year t:

- **Spread:** Bid-ask spread which is the difference between the best buyer price and best seller price (Gibson *et al*., 2003; Boehmer *et al*., 2005; Anand *et al*., 2009)
- **Depth_B:** Buyer-side depth; this entails the best buyer order amount (Bloomfield and O'Hara, 1999; Madhavan *et al*., 2005; Lescourret and Robert, 2011)
- **Depth_S:** Seller-side depth; this is the greatest seller order amount (Bloomfield and O'Hara, 1999; Madhavan *et al*., 2005; Lescourret and Robert, 2011)
- **Volatility:** Price volatility; the average of daily price volatilities (Madhavan *et al*., 2005; Chung and Chuwonganant, 2009)
- **ROE:** ROE represents the return on equity in the financial statements and is an indicator of company performance. (Cronqvist and Nilsson, 2003; Krishnan *et al*., 2011; Huseyin *et al*., 2012; Bhagat and Bolton, 2013)
- **Size:** Market value which represents company size (Lang and Lundholm, 1996; Yermack, 1996; Navissi and Naiker, 2006). We used the natural logarithm of this value
- **Institution:** Ownership of the institution which consists of the total shares of the three primary institutional investors (i.e., foreign investors, investment trust and the security dealer; McConnell and Servaes, 1990)
- **Age:** Company age; the duration was calculated from the date of company public listing to 2011
- **Industry:** Industry type; this is a dummy variable where companies in the electronics industry are coded as "1" and companies in the non-electronic industries are coded as "0" (Hunt *et al*., 2012)
- **Board:** Board member size is the total number of members on the board of directors of a company (Zahra and Pearce II, 1989)

Compared with variables provided on general financial statements, market quality variables can be used to precisely evaluate the influence of information asymmetry on analyst forecasts. We expected that high market quality reduces analysts' forecast errors. In other

words, a maximum spread denotes increased forecast errors; a great buyer and seller depth indicated reduced forecast errors and high spread volatility indicated increased forecast errors.

The regression model that represents analyst forecast error volatility is constructed as follows:

$$\text{Dispersion}_{i,t} = b_0+b_1\,\text{Spread}_{it}+b_2\,\text{Depth\_B}_{it}+b_3\,\text{Depth\_S}_{it}+b_4\,\text{Volatility}_{it}+b_5\text{ROE}_{it}+b_6\text{Size}_{it}+b_7\text{Institution}+b_8\,\text{AGE}_{it}+b_9\text{Industry}_{it}+b_{10}\text{Board}_{it}+\varepsilon_{it} \quad (2)$$

where, $\text{Dispersion}_{i,t}$ represents the volatility level of analyst forecasts; this can be further divided into the actual values ($\text{Dispersion}_{i,t}\_R$) and overall average values ($\text{Dispersion}_{i,t}\_A$). The definitions for the other variables remain as previously defined:

$$\text{Dispersion i,t\_R} = \text{std}\left(\frac{\left|\text{FEPS}_{i,t} - \text{AEPS}_t\right|}{P_t}\right)$$

$$\text{Dispersioni,t\_A} = \text{std}\left(\frac{\left|\text{FEPS}_{i,t} - \text{AFEPS}_t\right|}{P_t}\right)$$

where, i represents the analyst code; t denotes time; $\text{FEPS}_{i,t}$ represents i analyst's pre-event forecast of the EPS for the end of t year; AEPS_t denotes the actual EPS at the end of t year; AFEPS_t represents the overall analyst average of the EPS for the end of t year and P_t is the stock price at the beginning of year t.

Compared with data provided on general financial statements, the securities market quality variable can be used to evaluate the influence of information asymmetry on analyst forecast error volatility. Therefore, this study asserts that high market quality lowers the volatility of analysts' forecast error.

RESULTS AND DISCUSSION

This study investigated whether securities market quality influenced analysts' forecast errors and forecast error volatility by (a) Using the market microstructure approach to obtain data on securities market quality and (b) Employing statistical methods, such as descriptive statistics, the means test, the correlation coefficient and a regression model, to analyze relevant topics and discuss existing correlations.

Descriptive statistics on analyst forecast error and market quality: The descriptive statistics were used to obtain the overall sample condition and distributions. Table 1 shows the overall distributions of the analyst forecast samples. Regarding market quality, the average spread was 0.1488, the buyer-side depth was 2.8876, the seller-side depth was 2.8174 and price volatility was 0.0021. In addition, the purpose of using various methods to calculate analysts' forecast errors was to investigate the differences among reference values. Therefore, the calculated values were analyzed based on the absolute values. Reference values were used differently in two approaches: Method 1 involves using the actual value as reference value (mean = 0.0484 and forecast error volatility = 1.5358) and Method 2 entails using the overall average of all analyst forecasts as reference value (mean = 0.0333 and forecast error volatility = 0.7329). The results of the two approaches indicated that compared with Method 2, using Method 1 yielded greater forecast errors and volatility, suggesting that compared with using the actual values, analysts better predicted the future earnings using the overall average. In addition, the results showed that various analysts exhibited similar perspectives on market information and future trends in their forecasts.

Table 1: Characteristics of the sample

Variables	Mean	Q1	Median	Q3	Standard deviation	Minimum	Maximum
Dependent							
$\text{AFE}_{i,t}\_R$	0.0484	0.0077	0.0214	0.0506	0.1132	0.0000	6.0132
$\text{Dispersion}_{i,t}\_R$	1.5358	0.3717	0.7621	1.5690	2.5321	0.0000	32.0592
$\text{AFE}_{i,t}\_A$	0.0333	0.0333	0.0145	0.0056	0.0846	0.0000	4.3956
$\text{Dispersion}_{i,t}\_A$	0.7329	0.7543	0.3496	0.1453	1.3300	0.0000	25.4733
Market quality							
Spread	0.1488	0.0534	0.0783	0.1289	0.2386	0.0100	5.3571
Depth_B	2.8876	1.9128	2.6392	3.6725	1.3281	0.0000	9.9260
Depth_S	2.8174	1.8317	2.5593	3.6042	1.3399	0.0000	9.4353
Volatility	0.0021	0.0010	0.0014	0.0021	0.0063	0.0000	1.4900
Control							
ROE	12.1214	6.6200	12.2300	18.5000	14.5579	-143.7100	70.3400
Sizes	17.5429	16.3464	17.3830	18.6126	1.5362	13.4081	21.3985
Institution	29.9713	13.3000	27.1600	44.7900	19.5377	0.0300	78.6800
Age	15.9289	10.0000	12.0000	19.0000	10.7860	1.0000	50.0000
Industry	0.5500	0.0000	1.0000	1.0000	0.4975	0.0000	1.0000
Board	8.1867	6.0000	7.0000	9.0000	2.8966	4.0000	21.0000

Correlation coefficient matrix of analyst forecast error and market quality: A correlation coefficient matrix was devised to analyze the correlations between different variables and analysts' forecast error. This study found that a high market quality reduced analysts' forecast errors and forecast error volatility.

The correlation coefficients in Table 2 showed that when the market quality was high, low spread and low price volatility were positively correlated with high analyst forecast errors and high forecast error volatility. By contrast, great buyer-side and seller-sider depths were negatively correlated with high analyst forecast errors and high forecast error volatility. Thus, the results supported our hypotheses. The other variables, such as the ROE, market size, institutional ownership, age, non-electronic industry and board sizes, were all negatively correlated with analysts' forecast errors and forecast error volatility, thereby supporting the study hypotheses.

Sample means test of analysts' forecast error and securities market quality: The mean test was conducted to verify the differences in analysts' forecast errors and forecast error volatility under various conditions. Based on the literature, a high securities market quality indicated a low level of information asymmetry, reduced analyst uncertainty and low analyst forecast errors and volatility. Therefore, this study divided the variables according to the means into high group (>50%) and low group (= 50%) for comparing and examining the differences in these two groups to determine if significant differences existed and to verify the hypotheses proposed in this study.

Table 3 presents the results of the mean test in which variables were distinguished according to averages >50% or =50%. The two groups were compared to identify their differences in the forecast error and volatility. Regarding bid-ask spread, the forecast error (and forecast error volatility) of the high group was higher than that of the low group, indicating that high spread increased analysts' forecast error (and forecast error volatility). In terms of the buyer-side and seller-side depths, the forecast error (and forecast error volatility) of the high group was smaller than that of the low group, indicating that great depths reduced analysts' forecast error (and forecast error volatility). Concerning price volatility, the forecast error (and forecast error volatility) of the high group was greater than that of the low group, thus implying that analysts' forecast errors (and forecast error volatility) increased as price volatility increased. Regarding the other variables (i.e., ROE, market size, institutional ownership, age and board member size), the forecast

Table 2: Correlation coefficient matrix of market quality and analysts forecast

Parameters	Spread	Depth_B	Depth_S	Volatility	ROE	Sizes	Institution	Age	Industry	Board	AFE_{it}_A	$Dispersion_{it}$_A	AFE_{it}_R	$Dispersion_{it}$_R
Spearman correlation														
Spread	-	-0.5358***	-0.5248***	-0.0294***	0.5149***	-0.1312***	0.0314***	-0.3466***	0.2899***	-0.3538***	0.1929***	0.3005***	0.2189***	0.2362***
Depth_B	-0.1603***	-	0.9469***	-0.1445 ***	-0.2634***	0.6366***	0.3916***	0.3721***	-0.1349***	0.3584***	-0.0906***	-0.0303***	-0.1567***	-0.1105***
Depth_S	-0.1465***	0.9577***	-	-0.1364***	-0.2474***	0.6450***	0.4015***	0.3670***	-0.1330***	0.3573***	-0.0847***	-0.0244***	-0.1556***	-0.1173***
Volatility	0.0411***	-0.0844***	-0.0792***	-	-0.2596***	-0.3239***	-0.2863***	-0.0797***	-0.0751***	-0.0538***	0.1870***	0.0652***	0.1974***	0.1277***
ROE	0.3900***	-0.2125***	-0.1950***	-0.0391***	-	0.0947***	0.1935***	-0.0558***	0.1011***	-0.2360***	-0.2543***	-0.1663***	-0.1569***	-0.1626***
Sizes	0.1386***	0.6229***	0.6315***	-0.0443***	0.1230***	-	0.6869***	0.2721***	0.0009***	0.3507***	-0.0751***	-0.2785***	-0.0653***	-0.4265***
Institution	0.2019***	0.3897***	0.4009***	-0.0345***	0.2136***	0.6734***	-	0.1589***	0.1451***	0.1586***	-0.1393***	-0.2261***	-0.0337***	-0.3535***
Age	-0.1844***	0.2755***	0.2728***	-0.0204***	-0.0374***	0.2430***	0.0824***	-	-0.4399***	0.1253***	-0.0137***	-0.1531***	0.0018***	-0.1047***
Industry	0.1958***	-0.1286***	-0.1253***	-0.0005***	0.0077***	0.0136***	0.1772***	-0.4674***	-	-0.2355***	0.0506***	0.2950***	0.0487***	0.2913***
Board	-0.1778***	0.3548***	0.3530***	-0.0161***	-0.1652***	0.3502***	0.1094***	0.2883***	-0.3027***	-	-0.0321***	-0.1478***	-0.0095***	-0.0611***
Pearson correlation														
AFE_{it}_A	0.0733***	-0.0608***	-0.0562***	0.0302***	-0.3432***	-0.0483***	-0.1222***	-0.0472***	0.0386***	-0.0368***	-	0.2491***	-	-
$Dispersion_{it}$_A	0.5836***	-0.0570***	-0.0507***	0.0246***	0.2137***	-0.2516***	-0.2478***	-0.1439***	0.2448***	-0.1773***	0.1505***	-	-	-
AFE_{it}_R	0.0608***	-0.0564***	-0.0546***	0.0243***	-0.2178***	-0.0078***	-0.0740***	-0.0356***	0.0367***	-0.0260***	-	-	-	0.3164***
$Dispersion_{it}$_R	0.4281***	-0.0169***	-0.0235***	0.0123***	0.1984***	-0.3021***	-0.3028***	-0.1077***	0.2336***	-0.1260***	-	-	0.1103***	-

***Significant at 1% level

Table 3: Mean test of the market quality in analysts' earnings forecasts effect

	$AFE_{i,t}\_R$				$Dispersion_{i,t}\_R$			
	Mean				Mean			
Panel A	High (>50%)	Low (≤50%)	Difference	t-value	High (>50%)	Low (≤50%)	Difference	t-value
Market quality variable								
Spread	0.0528	0.0307	0.0221	70.31***	3.3887	1.0620	2.3267	343.32***
Depth_B	0.0416	0.0544	-0.0129	-51.11***	1.4694	1.6182	-0.1488	-25.19***
Depth_S	0.0410	0.0549	-0.0140	-55.40***	1.4573	1.6334	-0.1761	-29.81***
Volatility	0.0876	0.0417	0.0459	129.70***	1.5273	1.5371	-0.0098	-1.14
Control variable								
ROE	0.0333	0.0637	-0.0305	-121.98***	1.2815	1.7762	-0.4948	-84.58***
Sizes	0.0456	0.0509	-0.0053	-20.85***	1.0388	2.0001	-0.9613	-166.55***
Institution	0.0347	0.0600	-0.0253	-100.56***	1.1102	1.9809	-0.8707	-150.40***
Age	0.0449	0.0505	-0.0056	-21.77***	1.1539	1.7755	-0.6217	-103.75***
Industry	0.0523	0.0436	0.0088	34.69***	2.0881	0.8400	1.2481	217.64***
Board	0.0463	0.0498	-0.0034	-13.36***	1.0823	1.8602	-0.7779	-132.09***
	$AFE_{i,t}\_A$				$Dispersion_{i,t}\_A$			
	Mean				Mean			
Panel B	High (>50%)	Low (≤50%)	Difference	t-value	High (>50%)	Low (≤50%)	Difference	t-value
Spread	0.0360	0.0228	0.0132	56.22***	0.5242	1.5499	-1.0257	-295.52***
Depth_B	0.0289	0.0373	-0.0084	-44.34***	0.6956	0.7664	-0.0708	-24.07***
Depth_S	0.0287	0.0374	-0.0087	-46.25***	0.7066	0.7565	-0.0499	-16.94***
Volatility	0.0563	0.0294	0.0269	101.29***	0.7453	0.6604	0.0849	20.40***
Control variable								
ROE	0.0269	0.0399	-0.0130	-69.05***	0.5649	0.8972	-0.3323	-113.93***
Sizes	0.0332	0.0335	-0.0003	-1.38	0.4318	1.0656	-0.6338	-221.71***
Institution	0.0314	0.0345	-0.0032	-16.25***	0.5696	0.8332	-0.2636	-87.50***
Age	0.0266	0.0390	-0.0125	-66.10***	0.4726	1.0441	-0.5715	-198.24***
Industry	0.0299	0.0361	-0.0062	-3.15***	0.3893	1.0139	-0.6246	-217.43***
Board	0.0328	0.0337	-0.0008	-4.32***	0.5971	0.8251	-0.2280	-76.41***

Panel A is using the $AFE_{i,t}\_R$ to calculate the value of analysts' earnings forecast errors and forecast volatility is $Dispersion_{i,t}\_R$. Panel B is using the $AFE_{i,t}\_A$ to calculate the value of analyst forecast error and forecast volatility is $Dispersion_{i,t}\_A$., The market value of the quality variables and control variables are divided into two groups: One is the high group (greater than 50%) and the other is low group (less than 50%) and this part is in comparison with the analyst forecast error and volatility in significant differences between the two groups. ***Significant at 1% level

Table 4: Regression coefficients of analysts' earnings forecast error ($AFE_{i,t}\_R$) on the market quality effects

	Model 1		Model 2		Model 3		Model 4	
Parameters	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value
α	-0.0061	-3.52***	-0.0037	-1.98**	0.0011	0.55	0.0188	8.37***
Spread	0.0218	43.60***	-	-	-	-	0.0263	44.56***
Depth_B	-	-	-0.0015	-4.27***	-	-	-0.0012	-2.87***
Depth_S	-	-	-0.0027	-7.84***	-	-	-0.0032	-7.67***
Volatility	-	-	-	-	0.3253	12.05***	0.257	9.52***
ROE	-0.0029	-320.03***	-0.0027	-299.15***	-0.003	-304.45***	-0.0032	-282.14***
Sizes	-0.0083	-72.95***	-0.0082	-62.73***	-0.0086	-62.88***	-0.007	-44.04***
Institution	-0.0007	-76.49***	-0.0006	-75.30***	-0.0007	-66.41***	-0.0007	-69.07***
Age	-0.0004	-31.36***	-0.0005	-37.64***	-0.0005	-32.47***	-0.0004	-27.46***
Industry	-0.0003	-0.93	0.0011	3.73***	0.0035	10.06***	0.0028	8.03***
Board	-0.0041	-86.39***	-0.0044	-91.91***	-0.0046	-80.67***	-0.0044	-76.32***
Adj.R^2	0.1376		0.1357		0.1523		0.1550	

$AFE_{i,t}\_R = \alpha_0 + a_1 Spread_{it} + a_2 Log\_BD + a_3 Log\_SD + a_4 P\_Vol + a_5 ROE + a_6 Mv + a_7 Ins\_O + a_8 AGE + a_9 D + a_{10} B\_Size + \varepsilon_{it}$ **, ***Significant at the 1 and 5% levels, respectively

errors (and forecast error volatility) of the high group were smaller than those of the low group, whereas the forecast error (and forecast error volatility) of the high group for industry types was greater than that of the low group. These results supported those of previous studies (Lang and Lundholm, 1996; Boehmer *et al*., 2005), who asserted that high market quality reduced analysts' forecast errors (forecast error volatility).

Regression analysis results of analysts' earnings forecast errors and market quality: We adopted the two approaches of assessing the analysts' forecast error and

forecast error volatility to understand issues relevant to forecast errors and market quality. The first approach (Approach 1) involved using the differences between analysts' year-end forecasts and actual year-end values and forecast error volatility to investigate the influence of market quality on analysts' forecast errors. The second approach (Approach 2) involved using the differences among analysts' forecasts and the overall average of all analysts' forecast errors and forecast error volatility to determine whether market quality influenced the forecasts produced by different analysts.

In summary, the first part (Situation 1) examined the difference between analysts' forecasts and the actual value. The results presented in Table 4 indicated that when the spread was high, analysts' forecast errors increased which supported the hypothesis that poor market quality increased analysts' forecast errors. As indicated previously, this study expected that increased depth produces optimal market quality, thus, the differences between the forecasts and actual values or among analysts decrease. This phenomenon is shown in Table 4. When price volatility was high, market quality was low, suggesting a positive relationship between price volatility and analysts' forecast errors and supporting the study hypothesis (Abarbanell *et al*., 1995; Lang and Lundholm, 1996; Boehmer *et al*., 2005). The other control variables (i.e., the ROE, market size, institutional ownership, age, industry type and board size) were indicators used in corporate financial statements. Institutional ownership represents the shares of the three main company investors. Previous studies have stressed that because legal persons, compared with typical investors, possess more resources and power to inspect corporate management authorities, they generally release more internal corporate information into the market which increases information transparency, there by improving market quality. Therefore, we postulated that a high proportion of institutional ownership improves market quality and reduces analysts' forecast errors; the results supported this study's hypothesis. Company age represents the age at which companies are listed. This study asserts that companies that have been listed for long periods possess efficient internal auditing systems; therefore, these companies could not be easily manipulated by specific people or incidents which enhanced market quality and information transparency. Thus, older companies and high market quality reduced analysts' forecast errors. The results supported the hypothesis of this study. The industry type variables were coded 1 or 0 based on whether the company was in the electronics industry. Rapid product innovations in electronic industries engender shorter product lifecycles; therefore, electronic industries exhibit higher information asymmetry compared with that of non-electronics industries. Consequently, we posited that companies belonging to the electronics industry possess poor securities market quality which increases analysts' forecast errors; this finding corresponded to our expectations. Board member size is a crucial indicator in corporate ownership because the board of directors is the highest decision-making unit in a company. Large board size signifies that many people possessed internal corporate information; this increases the likelihood of information being dispersed in the market, thereby enhancing market quality. We maintained that large board size improved market quality and reduced analysts' forecast errors; the results supported this supposition.

The forecast error volatility results were similar to those obtained for forecast errors. Table 5 shows that when spread increased, analysts' forecast error volatility rose. As indicated above, this study assumed that when the buyer and seller-side depth was great, analysts'

Table 5: Regression coefficients of analysts' earnings forecast dispersion (Dispersion$_{i,t_R}$) on the market quality effects

	Model 1		Model 2		Model 3		Model 4	
Parameters	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value
α	-5.6194	-165.29***	-9.4636	-225.96***	-7.0173	-152.98***	-6.9399	-164.98***
Spread	4.8346	510.65***	-	-	-	-	4.8693	458.25***
Depth_B	-	-	-0.2066	-26.27***	-	-	-0.0458	-5.73***
Depth_S	-	-	-0.2194	-28.17***	-	-	-0.2007	-25.42***
Volatility	-	-	-	-	19.1551	31.16***	7.0007	13.44***
ROE	-0.0078	-45.07***	0.0121	60.73***	0.0218	101.69***	-0.0165	-80.68***
Sizes	-0.4138	-185.75***	-0.7597	-262.21***	-0.5522	-184.23***	-0.5434	-185.65***
Institution	-0.0013	-7.64***	0.0033	17.39***	0.0011	4.91***	0.0006	2.95***
Age	-0.0063	-24.92***	-0.0203	-71.34***	-0.0254	-74.64***	-0.0077	-26.38
Industry	0.4346	77.81***	0.552	85.85***	0.729	95.94***	0.395	60.77***
Board	-0.1165	-125.92***	-0.1564	-148.23***	-0.1811	-144.63***	-0.1254	-117.64***
Adj.R^2	0.4028		0.2173		0.1923		0.4221	

$Dispersion_{i,t\_}R = \alpha_0+b_1Spread_{it}+b_2Depth\_B_{it}+b_3Depth\_S_{it}+b_4Volatility_{it}+b_5ROE_{it}+b_6Size_{it}+b_7Institution_{it}+b_8AGE_{it}+b_9Industry_{it}+b_{10}Board_{it}+\varepsilon_{it}$, ***Significant at the 1% level

forecast error volatility decreased which was consistent with the results exhibited in Table 5. In addition, the results showed that high price volatility increased the volatility of analysts' forecast errors; a high proportion of institutional ownership, older companies and large board size reduced the volatility of analysts' forecast errors and electronics industry companies demonstrated increased the volatility of analysts' forecast errors. All of the results supported the study hypotheses (Abarbanell *et al*., 1995; Lang and Lundholm, 1996; Boehmer *et al*., 2005; Lescourret and Robert, 2011).

In the second part (Situation 2), we then investigated the differences between analysts' forecast values and the average values of all analyst forecasts. According to Table 6, when spread increased, analysts tended to disagree which corresponded to the proposed hypothesis that a low market quality engenders large forecast errors. This study expected that increased depth produces high market quality which enables analysts to acquire considerable information; thus, the differences between analyst cognition decrease. This phenomenon is demonstrated in Table 6. High price volatility indicated high transaction spread in the market and consequently reduced market quality, thereby increasing the forecast differences among analysts (Bloomfield and O'Hara, 1999; Madhavan *et al*., 2005; Lescourret and Robert, 2011). Thus, the study hypothesis was verified. The results for variables ROE, market size, institutional ownership, age, industry type and board sizes were similar to those obtained using Approach 1.

Table 7 summarizes the forecast error volatility results calculated using Approach 1. High spread increased analyst forecast error volatility. Furthermore, the results presented in Table 7 supported our assumptions on buyer-and seller-side depths (i.e., great depths reduced analyst forecast error volatility). In addition, high price volatility increased analyst forecast error volatility (Chung and Chuwonganant, 2009); a high proportion of institutional ownership, older companies and large board size diminished analyst forecast error volatility and companies in electronics industry enhanced analyst forecast error volatility. These findings typically corresponded to the proposed hypotheses. Furthermore, the results of forecast error volatility obtained using Approaches 1 and 2 were similar.

Table 6: Regression coefficients of analysts' earnings forecast error ($AFE_{i,t}\_A$) on the market quality effects

	Model 1		Model 2		Model 3		Model 4	
Parameters	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value
α	-0.0341	-25.37***	-0.0261	-17.97***	-0.0296	-18.25***	-0.0198	-11.22***
Spread	0.0024	6.01***	-	-	-	-	0.0028	5.98***
Depth_B	-	-	-0.0012	-4.52***	-	-	-0.0014	-4.06***
Depth_S	-	-	-0.0026	-9.76***	-	-	-0.0029	-8.89***
Volatility	-	-	-	-	0.2511	11.87***	0.2385	11.26***
ROE	-0.0013	-188.97***	-0.0013	-180.56***	-0.0015	-186.75***	-0.0014	-164.22***
Sizes	-0.0068	-76.11***	-0.0061	-59.90***	-0.0069	-64.65***	-0.0061	-48.82***
Institution	-0.0004	-64.05***	-0.0004	-64.80***	-0.0005	-59.37***	-0.0005	-60.46***
Age	-0.0003	-27.38***	-0.0003	-29.15***	-0.0003	-26.34***	-0.0003	-26.13
Industry	0.0018	8.05***	0.0023	10.27***	0.0040	14.81***	0.0043	15.76***
Board	-0.0024	-63.74***	-0.0024	-65.52***	-0.0026	-58.89***	-0.0026	-58.61***
Adj.R^2	0.0594		0.0597		0.0687		0.069	

$AFE_{i,t}\_A = \alpha_0+a_1Spread_{it}+a_2Log\_BD_{it}+a_3Log\_Sd_{it}+a_4P\_Vol_{it}+a_5ROE_{it}+a_6MV_{it}+a_7Ins\_O_{it}+a_8AGE_{it}+a_9IND_{it}+a_{10}B\_Size_{it}+\varepsilon_{it}$, ***Significant at 1% level

Table 7: Regression coefficients of analysts' earnings forecast dispersion ($Dispersion_{i,t}\_A$) on the market quality effects

	Model 1		Model 2		Model 3		Model 4	
Parameters	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value	Coefficient estimate	t-value
α	-5.6194	-165.29***	-9.4636	-225.96***	-7.0173	-152.98***	-6.9399	-164.98***
Spread	4.8346	510.65***	-	-	-	-	4.8693	458.25***
Depth_B	-	-	-0.2066	-26.27***	-	-	-0.0458	-5.73***
Depth_S	-	-	-0.2194	-28.17***	-	-	-0.2007	-25.42***
Volatility	-	-	-	-	19.1551	31.16***	7.0007	13.44***
ROE	-0.0078	-45.07***	0.0121	60.73***	0.0218	101.69***	-0.0165	-80.68***
Sizes	-0.4138	-185.75***	-0.7597	-262.21***	-0.5522	-184.23***	-0.5434	-185.65***
Institution	-0.0013	-7.64***	0.0033	17.39***	0.0011	4.91***	0.0006	2.95***
Age	-0.0063	-24.92***	-0.0203	-71.34***	-0.0254	-74.64***	-0.0077	-26.38
Industry	0.4346	77.81***	0.552	85.85***	0.729	95.94***	0.395	60.77***
Board	-0.1165	-125.92***	-0.1564	-148.23***	-0.1811	-144.63***	-0.1254	-117.64***
Adj.R^2	0.4028		0.2173		0.1923		0.4221	

$Dispersion_{i,t}\_A = \alpha_0+b_1Spread_{it}+b_2Depth\_B_{it}+b_3 Depth\_S_{it}+b_4 Volatility_{it}+b_5ROE_{it}+b_6 Size_{it}+b_7 Institution_{it}+b_8 AGE_{it}+b_9Industry_{it}+b_{10}Board_{it}+\varepsilon_{it}$, ***Significant at 1% level

CONCLUSION

Previous studies have used various data, including financial statements, to assess the factors that influence analysts' forecast errors. Financial statements available in the market are confounded by numerous factors which influence the accuracy of the information presented in the financial reports. Consequently, using financial statement data to evaluate company prospects is not an optimal approach.

To mitigate the confounding effects of human factors on financial information, this study adopted securities market quality data to investigate whether analysts' forecast errors were affected by information asymmetry. Securities market quality variables, including bid-ask spread, market depth and price volatility, can be used to assess the level of information asymmetry and whether differing information-asymmetry levels generate different analyst forecast errors.

Based on the empirical results of this study, the following two conclusions were obtained. First, high securities market quality (i.e., small spread, great buyer- and seller-side depths and low price volatility) reduced analysts' forecast errors and forecast error volatility. Second, the importance of information disclosure is reflected in the influence that securities market quality has on analysts' forecast errors. Increased information disclosure signifies a low level of information asymmetry in the market which not only prevented investors from collecting data but also decreased analysts' forecast errors. The results of this study provided competent authorities with a reference for formulating policies that focus on the importance of information disclosure to reduce market information asymmetry.

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