Strategic Disclosure Model for Insider’s Financial Forecast Information

Abstract

This study develops a theoretical model in which the voluntary disclosure of earnings forecast is a double-edged sword. Such disclosure may reduce the information asymmetry between investors and firms but simultaneously allows entrepreneurs create hype. Beginning from 2005 the disclosures of financial forecasts for Taiwanese public companies have not been mandatory, with firms being able to decide whether they wish to disclose such forecasts or not. This study devises a theoretical model for the disclosure decision, in which insider may manipulate information and investors can learn with bounded rationality. The analysis presented in this study demonstrates that a company may forgo earnings forecast disclosure. Considering forecast error costs in a multiperiod model, if the entrepreneur decides to voluntarily disclose financial forecasts, he should reduce the degree of manipulation. Additionally, the inferences of our model are examined based on forecasts issued by Taiwanese-listed firms. This study identifies a positive relationship between profit from insider trading and manipulation of earnings forecasts. Furthermore, the forecast error of voluntary disclosure may negatively impact firm value.

Keywords: Voluntary disclosure; Earnings forecast; Discretionary uninformed traders; Information manipulation.
1. Introduction

The recent wave of corporate finance scandals and accounting restatements has increased the demand for transparency in financial markets. These events have inspired finance and accounting research to focus on the quality and transparency of financial reports. The low level of information transparency and disclosure quality of public companies is grumbled in the East Asian region including Taiwan. To improve financial forecast quality, Taiwan changed its earnings forecast policy from mandatory to voluntary disclosure in 2005. The main reason for this change was that the regulations on mandatory disclosure of earnings forecasts encouraged managers to issue excessively optimistic earnings forecasts, with subsequently leading to reported earnings being managed upwards using discretionary accruals to reduce the forecast error (Jaggi, Chin, Lin and Lee 2006). The new policy on financial forecasts is more flexible than the old one, with listed companies voluntarily publishing financial forecasts in the form of either a “summary financial forecast” or “complete financial forecast”.

This study develops a model of earnings forecast manipulation that analyzes the expected trading profit of entrepreneur given voluntary disclosure. The main factors of our model are variability of inside information, manipulation and aggregate liquidity shocks. This study focuses on two main areas of interest. First, this study examines how the potential for manipulation influences expected insider profit. Second, this study uses the model to investigate the relationship between firm value and forecast error of voluntary disclosure in Taiwan.

According to the previous literatures, there is extensive evidence that increases in disclosure enhance shareholder value. However, Doidge, Karolyi and Stulz (2004) report that just one in ten large firms choose to increase their disclosure level by cross-listing their shares. These findings suggest that increase in disclosure is in the interest of shareholders, but not in the interests of those controlling the firm. The increased disclosure and associated internal control requirements introduced by the Sarbanes-Oxley Act of 2002 are frequently cited as catalysts in the recent movement to “go dark” (Leuz, Triantis, and Wang, 2004). During 2003 alone, 198 U.S. companies ceased filing with the SEC by deregistering their securities, but continued to trade on the OTC market, implying a significant reduction in disclosure and

---

1 In Taiwan, during the period 1991 to 2004, public companies were required to publish financial forecasts for the following fiscal year in any of the following circumstances: IPO, SEO, merger, or changes of one-third or more of the directors.
investor protection. Whether disclosure of firm financial information should be mandatory thus is an important question. Admati and Pfleiderer (2000) argue that there is a role for mandatory disclosure when firm values are correlated, disclosing information is costly and information asymmetries between firms and investors reduce firm values. Ostberg (2006) develops a model and shows that if the entrepreneur has issued debt prior to his disclosure choice, he may not wish to increase disclosure even though it is social welfare enhancing. Furthermore, the role of public is to narrow the information gap across investors so as to reduce the information asymmetry component of the cost of capital. However, Zhang (2001) derives a model and predicts that the cost of capital can be either positive or negative related to the disclosure level of the firm, depending on the specific factors that cause the variation.

The disclosure of earnings forecasts is more complicated than other financial information, due partly to earnings management. Kasznik (1999) provides evidence that managers use positive discretionary accruals to manage reported earnings upward when earnings would otherwise fall below management’s earnings forecasts. Chin et al. (2006) examine 528 forecasts issued by Taiwanese-listed firms from 1999 to 2001, and find that the firms with serious agency problems tended to revise their forecasts more to reduce error, or manipulate accruals more (e.g. through discretionary accruals) in order to avoid violating the 20percent forecast error threshold as the end of the period approached. The other problem is self-serving biases by management. Of late, several works have studied voluntary supplemental disclosure in relation to asset pricing. For example, Hughes and Pae (2004) propose a model of entrepreneur acquisition and voluntary disclosure of precision information. Their analysis shows that for estimates above (below) the prior expectation of the asset value, the entrepreneur discloses only high (low) precision information. The main idea is to enhance (diminish) confidence in estimates that improve upon (detract from) prior beliefs.

What distinguishes the analysis in this paper from that in other papers is that this study derives a disclosure model with earnings forecast manipulation and examines the interaction between strategic insider and discretionary uninformed traders. The analytical results demonstrate that as earnings volatility and volatility arising from insider manipulation increase, market participants face greater uncertainty regarding firm value. Insiders thus can achieve greater benefits from trading. The entrepreneur should reduce the degree of manipulation when considering forecast error costs in the multiperiod model.
The remainder of this paper is organized as follows. Section 2 describes the model. Section 3 then derives the equilibrium and illustrates the expected trading profits of entrepreneurs. Next, section 4 presents descriptive statistics and the results of the empirical tests. Finally, the last section presents concluding remarks. All proofs are shown in the appendix.

2. The model

This model has a structure that is similar to those in Kyle (1985) and Admati and Pfleiderer (1988). This study assumes that the entrepreneur is the only one insider and that there are a large number of liquidity traders. The model includes discretionary uninformed traders who make investment decisions based on earnings forecasts and learning about the quality of firm financial predictions. This study believes that the inclusion of these traders captures important elements of actual trading in financial markets.

Model description

An entrepreneur determines the disclosure policy of earnings forecast under the regulation of voluntary disclosure. The model of this study involves events taking place at five different stages.

Stage 1

Suppose an entrepreneur determines the firm’s disclosure policy of financial forecast at time 0. The market price of this firm is \( P_0 \), and the technology produces a risky cash flow at the end of the period, denoted \( \bar{x} \). It is common knowledge that \( \bar{x} = \bar{x} + \bar{v} \), where \( \bar{x} \) denotes the expected value, and it is assumed that \( P_0 = \bar{x} \). Furthermore, the variable \( \bar{v} \) is a random variable \( \bar{v} \sim N (0, \sigma^2_v) \).

There are three types of traders: insider, liquidity traders, who face uncertain liquidity shock, and uninformed traders, who adjust their investment decisions based on public information and learning about the quality of firm financial forecasts. We assume that the entrepreneur is the only one insider and there are a large number of liquidity traders and uninformed traders.

Stage 2

Only the entrepreneur privately receives information about \( \bar{v} \), while all other parties remain uninformed. The entrepreneur then decides whether the firm discloses earnings forecast. The public information of earnings forecast being announced is \( \bar{y} \).
Furthermore, it is assumed that $\hat{y} = \hat{v} + \bar{m}$, where $\hat{v}$ denotes private information and $\bar{m}$ represents that the entrepreneur intends to manipulate earnings forecast. The manipulation term $\bar{m}$ is a random variable, $\bar{m} \sim N(0, \sigma_{\bar{m}}^2)$ . We assumed that the random variables $\bar{m}$ and $\hat{v}$ are independently distributed. Furthermore, public signal $\hat{y}$ combines $\hat{v}$ and $\bar{m}$ so that $\hat{y} \sim N(0, \sigma_{\hat{v}}^2 + \sigma_{\bar{m}}^2)$ . Following the announcement of the public signal, given $y$, the conditional expectation of private information $\hat{v}$ is $E(\hat{v}|y) \sim N((\sigma_{\hat{v}}^2/(\sigma_{\bar{m}}^2+\sigma_{\hat{v}}^2))y, \sigma_{\hat{v}}^2/\sigma_{\bar{m}}^2)$. The public signal precision is $(\sigma_{\hat{v}}^2 + \sigma_{\bar{m}}^2)/\sigma_{\hat{v}}^2\sigma_{\bar{m}}^2$ . For simplicity, this study uses parameter $I$ to denote the precision of public report. $I = (\sigma_{\hat{v}}^2 + \sigma_{\bar{m}}^2)/\sigma_{\hat{v}}^2\sigma_{\bar{m}}^2 = 1/\sigma_{\hat{v}}^2 + 1/\sigma_{\bar{m}}^2$, $I > 0$.

Stage 3

At the end of the period, financial statements of the firm are announced. Based on the firm’s performance, investors are able to observe the earnings forecast error. We denote $\delta$ as the ratio of earnings forecast error, $\delta = (y_{t-1} - y)/|y|$. The cost of punishment associated with financial forecast error with precision parameter $I$ is $cf(I)$. The costs of financial forecast error include litigation costs, reputation costs, and cost of capital. This study assumes that $cf(I) \equiv b|\hat{\delta}(I)|$, $b>0$, and $\partial|\hat{\delta}(I)|/\partial I < 0$. Evidently, the increase of precision can reduce the cost associated with the financial forecast error.

Stage 4

There are three kinds of traders in our model, including only one insider and a large number of liquidity traders and uninformed traders. The asset market model is based on Kyle (1985), with competitive and risk-neutral market makers. At the beginning of the period, the insider chooses the quantity he trades $z$. The total amount of liquidity demand is denoted as $\tilde{q}$, and $\tilde{q} \sim N(0, \sigma_{\tilde{q}}^2)$ . Furthermore, the order flow traded by uninformed traders is denoted as $u$. This study assumes that uninformed traders make investment decisions based on public information and learning about firm predictive quality. Therefore, $u$ is conditional on financial forecast in this period and the financial forecast error of the previous period, $u|(y_t, (y_{t-1,a} - y_{t-1}))/|y_{t-1}|)$. Then the total market order is $D$, where $D = z + u + \tilde{q}$ . Each trader submits his market order realizing his effect on the total order flow. Moreover, the market maker sets a price

---

2 Beneish, Billings, and Hodder (2006) find that firms disclosing internal control material weaknesses under Section 302 of the Sarbanes-Oxley Act, experience an increase of 4.4 percent in the cost of equity.
that is a function of the total order flow so that his expected profit conditional on the
total order flow is zero.

Stage 5
The firm’s terminal value, equal to the cash flow less the cost of financial forecast
error, is realized and distributed to shareholders.

We illustrate the procedure of the model on figure 1.
1. Signal-period model

\[
\begin{align*}
 t=0 & \text{ (beginning) } & t=1 & \text{ (end)} \\
\text{The risky cash flow at the end, denoted } & \tilde{x} . \text{ It is common } & \text{knowledge that } & \tilde{x} = \bar{x} + \tilde{\nu} . \text{ Only the entrepreneur } \\
\text{privately receives the information about } & \tilde{\nu} . \text{ He decides } & \text{whether voluntary disclosure or not. The public } \\
\text{information he decided to disclose is } & \tilde{y} . \text{ And we assume } & \text{information he decided to disclose is } \\
\text{that } & \tilde{y} = \tilde{v} + \tilde{m} , \text{ where } \tilde{v} & \text{is private information and } \\
\text{is the part of manipulation. All traders trade after the public signal is announced.} & \tilde{m} & \text{is the part of manipulation. All traders trade after the public signal is announced.}
\end{align*}
\]

2. Two-period model

\[
\begin{align*}
\text{(end of period 1)( beginning of period 2)} \\
\text{t=0 (beginning of period 1)} & \text{ t=1 } & \text{ t=2 (end)} \\
\text{The firm’s terminal value,} & \text{equal to the cash flow from} & \text{The firm’s terminal value,} \\
\text{equal to the} & \text{production, is} & \text{equal to the cash flow } \bar{x} \\
\text{cash flow} & \text{realized and} & \text{less the cost of financial} \\
\text{production, is} & \text{distributed to} & \text{forecast error in period 1, is} \\
\text{realized and} & \text{shareholders.} & \text{realized and distributed to} \\
\text{distributed to} & \text{shareholders.} & \text{shareholders.}
\end{align*}
\]

Only the entrepreneur privately receives the information about \( \tilde{v} \). He decides whether voluntary disclosure or not. The public information he decided to disclose is \( \tilde{y} \). All traders trade after the public signal is announced.

The firm’s financial performance \( y_{1a} \) is announced. Investors could observe the financial forecast error. We denote \( \delta \) as the ratio of financial forecast error
\[
\delta = (y_{1a} - y_1) / y_1
\]

Only the entrepreneur privately receives the information \( \tilde{v}_2 \). He decides whether voluntary disclosure or not. The public information he decided to disclose is \( \tilde{y}_2 \). Uninformed traders make investment decisions based on \( \tilde{y}_2 \) and the financial forecast error in period 1.

\[\text{Uninformed traders make investment decisions based on } \tilde{y}_2 \text{ and the financial forecast error in period 1.}\]

\[\text{Only the entrepreneur privately receives the information } \tilde{v}_2 . \text{ He decides whether voluntary disclosure or not. The public information he decided to disclose is } \tilde{y}_2 . \text{ Uninformed traders make investment decisions based on } \tilde{y}_2 \text{ and the financial forecast error in period 1.}\]

\[\text{Uninformed traders make investment decisions based on } \tilde{y}_2 \text{ and the financial forecast error in period 1.}\]

\[\text{Uninformed traders make investment decisions based on } \tilde{y}_2 \text{ and the financial forecast error in period 1.}\]

**Figure 1. Procedure of the model.** This figure shows the procedures both in signal-period model and in two-period model of this study.
3. Voluntary disclosure

The model developed in this investigation is similar to those in Kyle (1985) and Admati and Pfleiderer (1988). The difference is that the proposed model includes discretionary uninformed traders who make investment decision based on public information and learning regarding firm predictive quality. The equilibrium is derived under various situations, including single period, two periods, and the case where the entrepreneur must hold a certain rate of shares to maintain ownership of the firm.

3.1 Single-period model

3.1.1 The case of non-disclosure

This study considers a single-period model involving just one informed trader, a number of liquidity traders, and numerous discretionary uninformed traders. All participants trade an asset with a terminal value $\bar{x}$. It is common knowledge that $\bar{x} = \bar{x} + \bar{v}$, where $\bar{x}$ denotes the expected value, and it is assumed that $p_0 = \bar{x}$.

The variable $\bar{v}$ is a random variable, $\bar{v} \sim N(0, \sigma^2)$, and is known only by the entrepreneur. The quantity traded by liquidity traders, denoted $\bar{q}$, is normally distributed with mean zero and variance $\sigma^2$. All traders trade after the public signal is announced.

First, this study assumes that the entrepreneur does not disclose financial forecasts. Furthermore, $W_0$ denotes the initial wealth of the insider. The insider chooses the quantity he wishes to trade, $z$. The market makers determine price $p$, at which they trade the quantity necessary to clear the market. The profit of the insider, denoted $\pi$, is given by $\pi = (\bar{x} - p) \cdot z$. The wealth of the insider at the end of the period is then given by

$$W_1 = W_0 + (\bar{x} - p) \cdot z$$

(1)

Using the assumptions of negative exponential utility and normal distributions, the objective function of insider is equivalent to choosing $z$ to maximize

$$E((\bar{x} - p) \cdot z \mid v, y) - \frac{\gamma}{2} Var((\bar{x} - p) \cdot z \mid v, y)$$

(2)

where $\gamma$ denotes the coefficient of absolute risk aversion. Suppose that the insider is risk neutral (namely, $\gamma = 0$), then the objective function of the insider is to maximize expected profit. The market maker follows a linear pricing strategy; that is, $p = p_0 + \lambda \cdot D$. The quantity $1/\lambda$ measures the depth of the market, and can be considered to represent the market liquidity of the stock. The following lemma is proved in the appendix.
Lemma 1. If the entrepreneur does not disclose earnings forecast \( y \), then in equilibrium insider submits a market order \( z = \beta \cdot v \), where \( \beta = \frac{1}{2\lambda} \), and
\[
\lambda = \frac{1}{2} \frac{\sigma_v}{\sigma_y}.
\]
The expected profit of the insider from trading with non-disclosure is
\[
E(\pi_N) = \frac{1}{4} \cdot \frac{1}{\lambda} \cdot \frac{\sigma_v^2}{\sigma_y^2} = \frac{1}{2} \sigma_v \sigma_q
\]
(3)

3.1.2 The case of voluntary disclosure
The entrepreneur releases earnings forecast \( y \). This study assumes that \( \tilde{y} = \tilde{v} + \tilde{m} \), where \( \tilde{v} \) denotes private information and \( \tilde{m} \) represents the degree that the entrepreneur intends to manipulate earnings forecast. The manipulation term \( \tilde{m} \) is a random variable, \( \tilde{m} \sim N(0, \sigma_m^2) \). Furthermore, the random variables \( \tilde{m} \) and \( \tilde{v} \) are independently distributed. The expectation of \( \tilde{v} \), conditional on public signal \( y \), is
\[
E(\tilde{v} \mid y = v + m) = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_m^2} (v + m)
\]
(4)
Furthermore, the conditional variance is
\[
Var(\tilde{v} \mid y = v + m) = \sigma_v^2 \left( 1 - \frac{\sigma_v^2}{\sigma_v^2 + \sigma_m^2} \right) = \frac{\sigma_v^2 \sigma_m^2}{\sigma_v^2 + \sigma_m^2}
\]
(5)

This study assumes that uninformed traders make investment decisions based on earnings forecast information. Define \( u \equiv \omega \cdot y \) in single-period; that is, \( u \) denotes the order flow of uninformed traders. Since the conditional expectation is \( E(v \mid y) = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_m^2} y \), so that this study assumes \( \omega = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_m^2} \). Furthermore, the insider is assumed to be risk neutral. The market maker then follows a linear pricing strategy; that is, \( p = p_o + \lambda \cdot D \). The following lemma is proved in the appendix.

Lemma 2. If the entrepreneur discloses financial forecast \( y \), then in equilibrium insider submits a market order \( z = -\frac{1}{2} \omega \cdot y + \beta \cdot v \), where \( \beta = \frac{1}{2\lambda} \). The equilibrium value of \( \lambda \) is given by

---

3 Uninformed traders are assumed to be practiced, and assess \( \sigma_v \) and \( \sigma_m \) based on their experiences and objective situations.
\[
\lambda = \frac{1}{2} \frac{\sigma_v}{\sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2}}
\]  

(6)

Furthermore, the expected profit of the insider is

\[
E(\pi_d) = \frac{1}{2} \sigma_v \sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2} - \frac{1}{2} \omega \sigma_v^2 + \frac{1}{8} \frac{\omega \sigma_v^3}{\sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2}}
\]

(7)

where \( \omega \) is assumed to be \( \omega = [\sigma_v^2 / (\sigma_v^2 + \sigma_m^2)] \)

The quantity \( 1/\lambda \) measures the depth of the market, and can be considered to represent the liquidity of the stock. Based on Lemma 2, liquidity is positively related to the variability of aggregate liquidity shocks. However, liquidity is negatively related to the variances of inside information and manipulation.

Lemma 3: Let \( E(\pi_d) \) represent the expected profit of the insider given voluntary disclosure. The entrepreneur discloses information only when their expected profit equals or exceeds that with non-disclosure. Thus disclosure of \( y \) will occur only if

\[
E(\pi_d) = \frac{1}{2} \sigma_v \sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2} - \frac{1}{2} \omega \sigma_v^2 + \frac{1}{8} \frac{\omega \sigma_v^3}{\sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2}} \geq \frac{1}{2} \sigma_v \sigma_q
\]

(8)

According to Lemma 1, the expected profit of insider given non-disclosure is \( \frac{1}{2} \sigma_v \sigma_q \). The order flow of uninformed traders is defined as \( u \equiv \omega y \), and it is assumed that \( \omega = \sigma_v^2 / (\sigma_v^2 + \sigma_m^2) \). Lemma 3 states that the probability of voluntary disclosure by the entrepreneur is low. The entrepreneur will disclose financial forecast information only when \( \sigma_v \) multiplied by \( \sigma_q \) is small and \( \sigma_m \) is sufficiently large. As an example, let \( \sigma_q = 0.5 \) and \( \sigma_v = 2 \). The expected profit of insider given non-disclosure is 0.5. In this case, if the entrepreneur discloses financial forecast information, \( \sigma_m \) should exceed 2.43. Thus, disclosure of imprecise information may take place in equilibrium. However, when the variance of firm cash flow is very small, for instance \( \sigma_v = 0.1 \), the expected profit of insider given disclosure is nearly the same as for non-disclosure. This model can explain the actual situation of voluntary disclosure of financial forecasts in Taiwan. Only a few firms disclose financial forecast information, and firms with stable cash flow, such as Chunghwa Telecom.
are more likely to disclose earnings forecasts. The implication of this model is consistent with the view of Yeo (1990) that as the earnings volatility decreases, managers have greater confidence in their ability to predict future trends and events.

Figure 2 helps in understanding the intuition behind lemma 2 and lemma 3. The figure is constructed for an example in which $\sigma_q=0.5$. The three lines denote simulated insider expected profit where $\sigma_v=1.6$, 2.0, and 2.4. Meanwhile, the horizontal axes comprise the levels of standard deviation of insider manipulation of disclosure. The figure reveals that insider’s expected profit clearly increases with $\sigma_v$ and $\sigma_m$.

**Figure 2. Expected trading profit of insider based on single-period model.** This figure shows the expected trading profit of insider using the simulation of single-period model. The figure is constructed for an example in which $\sigma_q=0.5$. The three lines denote simulated insider expected profit where $\sigma_v=1.6$, 2.0, and 2.4. Meanwhile, the horizontal axes comprise the levels of standard deviation of insider manipulation of disclosure. The expected trading profit of insider in the case of non-disclosure equals $\frac{1}{2}\sigma\sigma_q$, where its value equals 0.4, 0.5, and 0.6 respectively.

Below is a series of three figures simulating the expected profit of the insider to illustrate the effects of the three factors. In Fig. 3, given $\sigma_q=1.0$, insider expected profit is positively related to $\sigma_m$ and $\sigma_v$. We assume $\sigma_m=1.0$ in Fig. 4, and $\sigma_v=1.0$ in Fig. 5. Figure 5 shows that $\sigma_q$ dominates $\sigma_m$ in terms of the effects of
insider expected profit. In a market with more volatile liquidity shocks (a larger $\sigma_q$), it is difficult for the market maker to infer information from aggregate demand. Insiders thus can better conceal their private information, increasing expected profit.

Figure 3. Expected trading profit of insider given $\sigma_q=1.0$. This figure shows insider expected profit is positively related to $\sigma_m$ and $\sigma_v$.

Figure 4. Expected trading profit of insider given $\sigma_m=1.0$. This figure shows insider expected profit is positively related to $\sigma_q$ and $\sigma_v$.

Figure 5. Expected trading profit of insider given $\sigma_v=1.0$. This figure shows insider expected profit is positively related to $\sigma_m$ and $\sigma_q$. Meanwhile, $\sigma_q$ dominates $\sigma_m$ in terms of the effects of insider expected profit.
3.2 Two-period model

This section extends the model from Section 1 into a two-period model. The two-period model is considered in situations where the entrepreneur decides whether to disclose earnings forecast at the beginning of each period. Firm financial performance \( y_{1,a} \) is announced at the end of period 1. \( \delta \) is denoted as the ratio of the earnings forecast error, \( \delta = (y_{1,a} - y_1)/|y_1| \). The financial forecast error cost with precision parameter \( I \) is \( cf(I) \). This study assumes that \( cf(I) \equiv b|\delta(I)|, b>0 \). During period 2, discretionary uninformed traders make investment decisions based on financial forecasts and the earnings forecast error in period 1. We define \( u_2 = \omega_2 y_2 + \phi \delta \); that is, \( u_2 \) denotes the order flow of uninformed traders in period 2. The parameter \( \phi \) is assumed to be positive and \( \partial \phi / \partial |\delta| < 0 \).

Suppose the entrepreneur discloses earnings forecast \( y_2 \) at the beginning of period 2. It is then assumed that \( \tilde{y}_2 = \tilde{v}_2 + \tilde{m}_2 \), where \( \tilde{v}_2 \) denotes private information in period 2. The manipulation term \( \tilde{m}_2 \) is a random variable, \( \tilde{m}_2 \sim N(0, \sigma^2_{m_2}) \). Furthermore, the random variables \( \tilde{m}_2 \) and \( \tilde{v}_2 \) are independently distributed. The expectation of \( \tilde{v}_2 \), conditional on public signal \( y_2 \), is

\[
E[v_2 \mid (y_2 = v_2 + m_2)] = \frac{\sigma^2_{v_2}}{\sigma^2_{v_2} + \sigma^2_{m_2}}(v_2 + m_2)
\]

(9)

Additionally, the conditional variance is

\[
Var[v_2 \mid (y_2 = v_2 + m_2)] = \sigma^2_{v_2} \left(1 - \frac{\sigma^2_{v_2}}{\sigma^2_{v_2} + \sigma^2_{m_2}}\right) = \frac{\sigma^2_{v_2} \sigma^2_{m_2}}{\sigma^2_{v_2} + \sigma^2_{m_2}}
\]

(10)

For simplicity, this study uses parameter \( I_2 \) to denote the precision of earnings forecast in period 2. \( I_2 = (\sigma^2_{v_2} + \sigma^2_{m_2})/\sigma^2_{v_2} \sigma^2_{m_2} = 1/\sigma^2_{v_2} + 1/\sigma^2_{m_2}, I_2 > 0 \). This study assumes the firm terminal value equals the cash flow minus the cost of financial forecast error. Thus, \( p_2 \) can be denoted as \( p_2 = E(\bar{x} \mid D_2) - cf(I_1) \). At the beginning of period 2, the market price is adjusted to \( p'_i \), and it is assumed that \( p'_i = p_i - cf(I_1) \). The market maker follows the pricing strategy; that is, \( p_2 = p'_i + \lambda_2 D_2 \). The following lemma is demonstrated in the appendix.

Lemma 4. If the entrepreneur discloses financial forecast \( y_1 \) in period 1 and \( y_2 \) in period 2, then in equilibrium insider submits a market order of \( z_2 = -\frac{1}{2} \omega_2 y_2 - \frac{1}{2} \phi \delta + \beta_2 v_2 \), where \( \beta_2 = \frac{1}{2 \lambda_2} \). The equilibrium value of \( \lambda_2 \) is given by

\[
\lambda_2 = \frac{\frac{1}{2} \sigma_{v_2}}{\sqrt{\frac{1}{2} \omega^2 \sigma_{v_2}^2 + \frac{1}{2} \omega^2 \sigma_{m_2}^2 + \sigma_{v_2}^2}}
\]

(11)
And the expected profit of the insider from trading in period 2 is

\[
E(\pi_2) = \frac{1}{4} \lambda_2 \sigma_{v_2}^2 - \frac{1}{2} \sigma_{\omega}^2 \sigma_{v_2}^2 + \frac{1}{4} \lambda_2 \sigma_{\omega}^2 (\sigma_{v_2}^2 + \sigma_{m_2}^2) + \frac{1}{4} \lambda_2 \phi^2 \delta^2
\]  

where \( \omega_2 \) is assumed to be \( \omega_2 = \sigma_{v_2}^2 / (\sigma_{v_2}^2 + \sigma_{m_2}^2) \).

The expected profit of the insider from trading during period 2 is derived as follows. Suppose \( \sigma_q = \sigma_{q_2} \), \( \sigma_v = \sigma_{v_2} \), and \( \sigma_m = \sigma_{m_2} \), we compare insider expected profit \( E(\pi_1) \) with \( E(\pi_2) \) and obtains the result \( E(\pi_2) - E(\pi_1) = \frac{1}{4} \lambda_2 \phi^2 \delta^2 \). Since \( \lambda_2 \) and earnings forecast error in period 1 (\( \delta \)) increase, the expected profit for the insider is greater during period 2. Consequently, the insider has a greater incentive to manipulate financial forecasts during period 1.

Figure 6 helps to understand the intuition behind lemma 4. It is constructed for an example in which \( \sigma_q = 0.5 \), and \( \phi = 0.6 \). The ratio of earnings forecast error in period 1 (\( \delta \)) is set equal to -0.4. The three lines simulate insider expected profit during period 2, in which \( \sigma_v = 1.6, 2.0, \) and \( 2.4 \). The horizontal axes indicate the standard deviation of insider manipulation of disclosure. The figure shows that expected profit from insider trading clearly increases in the levels of \( \sigma_{v_2} \) and \( \sigma_{m_2} \).

**Figure 6. Expected trading profit of insider based on two-period model.** This figure shows the expected trading profit of insider using the simulation of two-period model. It is constructed for an example in which \( \sigma_q = 0.5 \), and \( \phi = 0.6 \). The ratio of earnings forecast error in period 1 is set equal to -0.4. The three lines simulate insider expected profit during period 2, in which \( \sigma_v = 1.6, 2.0, \) and \( 2.4 \).
The results in this section are intuitive. As earnings volatility ($\sigma_v$) and insider manipulation volatility ($\sigma_m$) increase, market participants face greater uncertainty regarding firm value, increasing potential benefits to insiders. Furthermore, according to lemma 4, as earnings forecast error in period 1 ($\delta$) increases, the profit for insiders during period 2 also increases. This increases insider incentive to manipulate financial forecasts in period 1. Entrepreneur thus benefits from disclosure when public signals are imprecise. This study denotes public signal precision as $I = (\sigma_v^2 + \sigma_m^2) / (\sigma_v^2 \sigma_m^2) = 1 / \sigma_v^2 + 1 / \sigma_m^2$. An increase in either $\sigma_v$ or $\sigma_m$ causes a decrease in $I$, while a decrease in $I$ increases insider’s expected profit.

3.3 Sustainable management model

This section discusses the issue of the entrepreneur having to hold a certain ratio of total shares to maintain ownership. According to article of “Rules for Director and Supervisor Share Ownership Ratios at Public Companies” in Taiwan, when paid-in capital of a company exceeds NT$2 billion, the total registered shares owned by all directors shall not be less than five percent of total issued shares. This study assumes that the entrepreneur owns $k$ percent of all issued shares. Furthermore, $S$ denotes [the total issued shares of the firm. We further assume that entrepreneur wealth, denoted by $W$, includes shares in the firm and riskless assets. The wealth of the insider is given by

$$W = k \cdot S \cdot p + F$$

where $p$ denotes stock price and $F$ represents the value of riskless assets. Therefore, to maximize his wealth, the entrepreneur should maximize firm stock price. According to the two-period model described in the previous section, $p_2 = p_1 + \lambda_2 D_2$, where $p_1 = p_1 - cf(I_1)$ and

$$\lambda_2 = \frac{\frac{1}{2} \sigma_{v_2} + \frac{1}{4} \omega_{v_2} \sigma_{v_2}^2 + \frac{1}{4} \omega_{v_2} \sigma_{m_2}^2 + \sigma_{q_2}^2}{\sqrt{4 \omega_{v_2}^2 \sigma_{v_2}^2 + 4 \omega_{v_2}^2 \sigma_{m_2}^2 + \sigma_{q_2}^2}}$$

$$D_2 = \beta_2 v_2 + \frac{1}{2} \omega_2 v_2 + \frac{1}{2} \omega_2 m_2 + \frac{1}{2} \phi \delta + \tilde{q}_2$$

This study denotes $\delta$ as the ratio of earnings forecast error. The cost of penalties associated with financial forecast error given precision parameter $I$ is $cf(I)$. This study defines $cf(I) = b |\delta(I)|$, $b > 0$, and $\partial |\delta(I)| / \partial I < 0$. Evidently, the increase in precision can reduce the cost associated with financial forecast error. In this multiperiod model in which the entrepreneur must hold a certain percentage of shares to maintain ownership, it is inferred that if the entrepreneur decides to voluntarily
disclose their earnings forecast, the optimal strategy would be to announce a slightly optimistic earnings forecast.

According to the proposed models, the following two hypotheses are tested:

H1: There is a positive relationship between insider trading profit and manipulation of earnings forecasts.

H2: A negative relationship exists between firm value and earnings forecast error of voluntary disclosure.

4. Empirical analysis

4.1 Sampling and data sources

The sample includes Taiwanese publicly-listed companies that disclose earnings forecasts voluntarily. The sample period runs from 2005 to 2006. This period is selected because it witnessed the introduction of a new policy regarding earnings forecast disclosure in Taiwan. The study sample includes 131 firms, with 97 disclosing earnings forecast voluntarily during 2005 while only 34 did so during 2006. In this investigation, we examine voluntary earnings disclosure. The voluntary forecasts and financial information were retrieved from the Taiwan Economic Journal (TEJ) database and the Market Observation Post System of the Taiwan Stock Exchange.

4.2 Calculation of forecast error and Tobin’s Q

In this study, Forecast error (FE) is calculated as the difference between actual earnings (AE) and predicted earnings (PE) divided by the absolute value of predicted earnings. If FE is greater than zero, actual earnings exceed predicted earnings.

\[
FE = \frac{AE - PE}{|PE|} \quad (16)
\]

We use quarterly forecasts and results to conduct empirical analyses. Calculations of forecast error can be based on initial predictions, the first revision of predictions, or the last revision of predictions. However, most forecasts were revised only once. This study uses the nearest prediction of this quarter to calculate forecast errors.

This study uses Tobin’s Q as the measurement of firm value. Tobin’s Q is calculated using the relationship between the market value of the company and the replacement value of its assets. This indicator reveals the potential added value of the firm as perceived by the market and thus reflects firm performance. If Tobin’s Q is
greater than 1.0, it indicates that the company has a market value exceeding the price the replacement cost of its assets. In this case, Tobin’s Q is calculated using an approach proposed by Chung and Pruitt (1994), which is easy to implement. The approximate value of Tobin’s Q is thus obtained simply as shown by the following equation.

$$Q = \frac{VMA + CL - CA + LTD}{AT}$$  \hspace{1cm} (17)

where $VMA$ denotes the market value of the stocks. The value of $VMA$ is calculated simply by multiplying the number of stocks of the company by price quoted by the Stock Exchange. $AT$ denotes total firm assets as evaluated by book value. Furthermore, $CL$ represents the book value of the current liability of the company. Additionally, $CA$ represents the book value of current firm assets, while $LTD$ denotes the book value of long-term debts. Asset replacement value is denoted by $AT$. In this way $Q$ thus can be easily calculated based on simple information found in the financial statement of any company.

### 4.3 Empirical results

#### 4.3.1 Statistical analysis of forecast errors

Based on the statistics presented in this study, eight firms adjusted reported earnings upwards. Meanwhile, 28 firms revised their earnings forecasts downwards, including six firms that issued two downwards revisions of earnings forecasts. The study sample includes 131 firms, all of which firms disclosed their earnings forecasts voluntarily. The empirical results reveal that 72.5% of firms did not violate the 20 percent forecast error threshold.

Most previous studies were based on annual forecasts. This study uses quarterly forecasts to analyze the forecast errors. The nearest prediction is used to calculate the forecast error. When the forecast error is calculated quarterly, it is found that the percentage of firms with a forecast discrepancy of below 20 percent in pre-tax profit or loss is 45.45%. The mean forecast error is thus -0.0132 while the median is -0.0031, indicating that firm forecasts tend to be biased on the optimistic side.

#### 4.3.2 Trading profit and manipulation of earnings forecasts

During the sample period, there are 8 firms adjusting the reported earnings upward. However, 28 firms revised earnings forecasts downward once, while six firms revised earnings forecasts downwards twice. The event date was taken as the firm announcement of an earnings forecast revision. We observe firm stock price before
and after the event date. For example, insiders can sell short prior the announcement of a downwards revision in earnings forecasts, and can buy back after the price fall. Discrepancy in firm earnings forecasts is used as the proxy of earning forecast manipulation. This study calculates the rate of return of firm stock price around the announcement of an earnings forecast revision as the potential trading profit of insiders. The Pearson’s correlation of trading profit and manipulation of earnings forecast is 0.44, and is significant at the 1% level. This empirical result supports H1, namely that a positive relationship exists between insider trading profit and manipulation of earnings forecast.

**4.3.3 Firm value and earnings forecast error**

Publicly-listed companies in Taiwan are required to release quarterly financial statements. Furthermore, listed companies in Taiwan are also required to release annual reports in April of each year. Half-yearly reports are released in August, with quarterly results being released in April and October. The results of multiperiod model obtained in this study imply that earnings forecast error under a situation of voluntary disclosure reduces firm value. This study uses Tobin’s Q to measure firm value. The market value of the stock is calculated using the market price at the end of the month following the release of the financial statements. The stock price is adjusted during this period and earnings forecast error may be one of the factors affecting stock price. This study analyzes firm value by using the following regression with panel data. The following model is estimated by fixed-effects estimator, and quarterly data is used. The analysis considers lagged one period firm value, the absolute forecasting error, and firm size as explanatory variables.

\[
Q_{i,t} = \alpha_i + b_1 \cdot Q_{i,t-1} + b_2 \cdot AFE_{i,t} + b_3 \cdot \text{Size}_{i,t} + \varepsilon_{i,t}
\]  

(18)

Where \(Q\) denotes the measurement of the firm value, and \(AFE\) represents the absolute value of quarterly forecast error. \(\text{Size}\) is calculated by the natural logarithms of firm market value. Table 1 lists the summary statistics obtained from the panel data estimation of equation (18). The estimated coefficient on \(AFE\) is nearly significantly negative at the 0.1 level, consistent with the prediction that there is a negative relationship between firm value and earnings forecast error.
Table 1. Results from panel data analysis

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_{t-1}$</td>
<td>1.0044</td>
<td>0.0179</td>
<td>56.2385</td>
<td>0.0000</td>
</tr>
<tr>
<td>AFE</td>
<td>-0.0640</td>
<td>0.0389</td>
<td>-1.6470</td>
<td>0.1012</td>
</tr>
<tr>
<td>SIZE</td>
<td>-0.0446</td>
<td>0.0249</td>
<td>-1.7901</td>
<td>0.0750</td>
</tr>
</tbody>
</table>

Notes: Variable definitions: $Q$ denotes the measurement of the firm value, and $AFE$ represents the absolute value of quarterly forecast error. $Size$ is calculated by the log value of firm market value. Equation (18) is estimated by fixed-effects estimator with Instrumental Variables (IV), using as instruments lagged firm value, lagged firm size, earnings per share, ratio of net income to net sales, and industry. Industry is a dummy variable that expresses the sector of operation of the company. The received value = 1 if the company is electronics sector. The panel data consists of 99 cross-sections and 4 observations in a cross-section. Adjusted R-squared is 0.73.

5. Conclusion

It is debatable whether disclosure of earnings forecast should be mandated by regulation or not. Beginning from 2005 the disclosure policy of financial forecasts for Taiwanese public companies has been changed from mandatory disclosure to voluntary disclosure. This study develops a strategic disclosure model that analyzes the expected trading profit of entrepreneur given voluntary disclosure of earnings forecast. It is assumed that the entrepreneur is the only one insider, and discretionary uninformed traders make investment decisions based on earnings forecasts and the quality of firm financial predictions. The proposed models in this study provide several empirical implications. The first prediction follows from Lemma 3 is that most firms will not voluntarily disclose earnings forecast. Our analysis reveals that the entrepreneur will disclose financial forecast information only when standard deviation of cash flow multiplied by standard deviation of aggregate liquidity is small and variability of earnings forecast manipulation is sufficiently large. There were 97 firms disclosed earnings forecast voluntarily during 2005 while only 34 firms did so during 2006 (about 3% of the total Taiwan-listed companies). Due to the mandatory forecast requirements in 2004, 688 companies were required to disclose earnings forecasts during this year. Bradbury (1992) finds that managers choose the safest method of disclosure, either non-quantified disclosure or non-disclosure, conditional on other moderating factors. Under the new earnings forecast disclosure policy, the disclosures are not mandated by legislation. Meanwhile, the number of disclosing firms decreases. However, many firms hold investor conferences to illustrate their performance. There
is room for further investigation.

The second implication is that if the entrepreneur decides to disclose earnings forecast, he tends to disclose optimistic earnings forecast. The analytical results demonstrate that as earnings volatility and volatility arising from insider manipulation increase, market participants face greater uncertainty regarding firm value. Insiders thus can achieve greater benefits from trading. In Taiwan, if financial forecast error is under 20 percent in pre-tax profit, the firm does not need to revise its financial forecasts. Considering forecast error costs in a multiperiod model, the entrepreneur would reduce the degree of manipulation. Our empirical results reveal that voluntary disclosures of earnings forecasts tend to be biased on the optimistic side. Moreover, the empirical results of Jaggi et al. (2006) also show that Taiwanese IPO firms issue more optimistic forecasts than conservative forecasts. The implication of this study is consistent with the view of Langberg and Sivaramakrishnan (2006). They analyze the voluntary disclosure decision of a manager when analysts scrutinize the quality of disclosure, and propound that managers voluntarily disclose unfavorable information only if sufficiently precise, but disclose favorable news with lower levels of accuracy.

This paper develops a disclosure model based on earnings forecast manipulation of insider and examines the interaction between strategic insider and discretionary uninformed traders. We show that the liquidity of the stock is positively related to the variability of aggregate liquidity shocks. However, liquidity is negatively related to the variances of inside information and manipulation. Furthermore, this study simulates the expected profit of the insider to illustrate the effects of the variables. In a market with more volatile liquidity shocks, it is difficult for the market maker to infer information from aggregate demand. Insiders thus can better conceal their private information, increasing expected profit. Meanwhile, an increase in either earnings volatility or insider manipulation volatility causes a decrease in public signal precision, while a decrease in precision of earnings forecast increases insider expected profit from trading. The empirical research of this study offers the contribution for a better understanding of the associations between the firm value and earnings forecast error of voluntary disclosure. The inferences of theoretical model are examined based on forecasts issued by Taiwanese-listed firms. This study identifies a positive relationship between profit from insider trading and manipulation of earnings forecasts.
Appendix

Proof of Lemma 1

All participants trade an asset with a terminal value $\tilde{x}$. It is common knowledge that $\tilde{x} = \bar{x} + \tilde{v}$, where $\bar{x}$ denotes the expected value, and it is assumed that $p_0 = \bar{x}$.

At the beginning of the period, the insider chooses the quantity he trades $z$. The total amount of liquidity demand is denoted as $\tilde{q}$, and $\tilde{q} \sim N(0, \sigma_\tilde{q}^2)$. Furthermore, this study assumes that uninformed traders make investment decisions based on earnings forecast information. Define $u \equiv \omega y$ in single-period; that is, $u$ denotes the order flow of uninformed traders. Then the total market order is $\tilde{D}$, where $\tilde{D} = z + u + \tilde{q}$. The expected trading profit of insider given his private information and public signal of earnings forecast is

$$\pi = E[((\bar{x} + \tilde{v}) - p) \cdot z \mid v, y] = E[((p_0 + \tilde{v}) - p) \cdot z \mid v, y]$$

(A.1)

where $p = p_0 + \lambda \cdot D$ and $D = z + u + \tilde{q}$.

First, this study assumes that the entrepreneur does not disclose financial forecasts. Since it is assumed $\tilde{v} \sim N(0, \sigma_\tilde{v}^2)$, uninformed traders’ expectation of $\tilde{v}$ without public signal is $E(\tilde{v}) = 0$. The order flow of uninformed traders in the case of non-disclosure is $u = 0$. The expected trading profit of insider given non-disclosure is

$$E(\pi_N) = v \cdot z - \lambda \cdot z^2$$

(A.2)

Taking the first-order condition, $d\pi / dz = 0$, and rearranging yield

$$z = \frac{1}{2\lambda} v \quad \text{and} \quad \beta = \frac{1}{2\lambda}$$

The market maker sets a price that is a function of the total order flow so that his expected profit conditional on the total order flow is zero. The market maker’s expectation of $\tilde{v}$, condition on $D$, is

$$E(\tilde{v} \mid D) = \frac{\beta \sigma_\tilde{v}^2}{\beta^2 \sigma_\tilde{v}^2 + \sigma_\tilde{q}^2} \cdot D$$

(A.3)

where $\beta = \frac{\sigma_u}{\sigma_\tilde{v}}$, and $\lambda = \frac{1}{2} \frac{\sigma_\tilde{v}}{\sigma_\tilde{q}}$

The ex ante expected profit of the insider from trading with non-disclosure is

$$E(\pi_N) = \frac{1}{4} \lambda \cdot \sigma_\tilde{v}^2 = \frac{1}{2} \sigma_\tilde{v} \cdot \sigma_\tilde{q}$$

(A.4)
Proof of Lemma 2

The entrepreneur releases earnings forecast \( y \). This study assumes that \( \tilde{y} = \tilde{v} + \tilde{m} \), where \( \tilde{v} \) denotes private information and \( \tilde{m} \) represents the degree that the entrepreneur intends to manipulate earnings forecast. The manipulation term \( \tilde{m} \) is a random variable, \( \tilde{m} \sim N(0, \sigma_m^2) \). Furthermore, the random variables \( \tilde{m} \) and \( \tilde{v} \) are independently distributed. The expected trading profit of insider given his private information and public signal of earnings forecast is

\[
\pi = E\{[(\tilde{x} + \tilde{v}) - p] \cdot z \mid v, y\} = v \cdot z - \lambda \omega y \cdot z - \lambda \cdot z^2
\]

(A.5)

where \( p = p_o + \lambda \cdot D \), \( D = z + u + \tilde{q} \), and \( u \equiv \omega y \).

Taking the first-order condition on equation (A.5)

\[
\frac{d\pi}{dz} = v - \lambda \omega y - 2 \lambda \cdot z = 0
\]

Then, \( z = -\frac{1}{2} \omega y + \frac{1}{2\lambda} v \), \( \beta = \frac{1}{2\lambda} \).

The market maker’s expectation of \( \tilde{v} \), condition on \( D \), is

\[
E(\tilde{v} \mid D) = E[\tilde{v} \mid (\frac{1}{2} \omega + \beta)v + \frac{1}{2} \omega m + \tilde{q}]
\]

(A.6)

\[
E(\tilde{v} \mid D) = \frac{1}{A}(\beta + \frac{1}{2} \omega)\sigma_v^2 \cdot D
\]

(A.7)

where \( A = (\beta + \frac{1}{2} \omega)^2 \sigma_v^2 + (\frac{1}{2} \omega)^2 \sigma_m^2 + \sigma_q^2 \)

Substituting \( \beta = \frac{1}{2\lambda} \) for equation (A.7), and rearranging yields

\[
\lambda = \frac{\frac{1}{2} \sigma_v}{\sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2}}
\]

(A.8)

The ex ante expected profit of the insider from trading with disclosure is

\[
E(\pi_D) = \frac{1}{4\lambda} \sigma_v^2 - \frac{1}{2} \omega \sigma_v^2 + \frac{1}{4} \lambda \omega^2 (\sigma_v^2 + \sigma_m^2)
\]

(A.9)

Substituting (A.8) for equation (A.9), and rearranging yields

\[
E(\pi_D) = \frac{1}{2} \sigma_v \sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2} - \frac{1}{2} \omega \sigma_v^2 + \frac{1}{8} \omega \sigma_v^3 \sqrt{\frac{1}{4} \omega^2 \sigma_v^2 + \frac{1}{4} \omega^2 \sigma_m^2 + \sigma_q^2}
\]

(A.10)
Proof of Lemma 4

We extend the model into a two-period model. The financial performance of firm $y_{1,a}$ is announced at the end of period 1. $\delta$ is denoted as the ratio of the earnings forecast error, $\delta = (y_{1,a} - y_1) / |y_1|$. The financial forecast error cost with precision parameter $I$ is $cf(I)$. During period 2, discretionary uninformed traders make investment decisions based on financial forecasts and the earnings forecast error in period 1. We define $u_2 = \omega_2 y_2 + \phi \delta$; that is, $u_2$ denotes the order flow of uninformed traders in period 2. The parameter $\phi$ is assumed to be positive and $\partial \phi / \partial |\delta| < 0$. This study assumes the firm terminal value equals the cash flow minus the cost of financial forecast error. Thus, $p_2$ can be denoted as $p_2 = E(\tilde{x} | D_2) - cf(I_1)$. At the beginning of period 2, the market price is adjusted to $p'_1$, and it is assumed that $p'_1 = p_1 - cf(I_1)$. The expected trading profit of insider given his private information and public signal of earnings forecast in period 2 is

$$\pi_2 = E\{[(p_1 - cf(I_1) + \tilde{v}_2) - p_2] \cdot z_2 | v_2, y_2\} \quad (A.11)$$

where $p_2 = p'_1 + \lambda_2 \cdot D_2$, $\tilde{D}_2 \equiv z_2 + u_2 + \tilde{q}_2$, and $u_2 = \omega_2 y_2 + \phi \delta$.

Taking the first-order condition on equation (A.11)

$$\frac{d \pi_2}{dz_2} = v_2 - \lambda_2 \omega_2 y_2 - \lambda_2 \phi \delta - 2 \lambda_2 \cdot z_2 = 0$$

Then, $z_2 = -\frac{1}{2} \omega_2 y_2 - \frac{1}{2} \phi \delta + \frac{1}{2 \lambda_2} v_2$, and $\beta = \frac{1}{2 \lambda_2}$.

The market maker’s expectation of $\tilde{v}_2$, condition on $D_2$, is

$$E(\tilde{v}_2 | D_2) = E[\tilde{v}_2 | \beta v_2 + \frac{1}{2} \omega_2 v_2 + \frac{1}{2} \omega_2 m_2 + \frac{1}{2} \phi \delta + \tilde{q}_2] \quad (A.12)$$

By standard properties of normal variables

$$E[\tilde{v}_2 | D_2] = \frac{(\beta_2 + \frac{1}{2} \omega_2) \sigma_{v_2}^2}{(\beta_2 + \frac{1}{2} \omega_2)^2 \sigma_{v_2}^2 + (\frac{1}{2} \omega_2)^2 \sigma_{m_2}^2 + \sigma_{q_2}^2} \cdot D_2 \quad (A.13)$$

Substituting $\beta = \frac{1}{2 \lambda}$ for equation (A.13), and rearranging yields

$$\lambda_2 = \frac{\frac{1}{2} \sigma_{v_2}}{\sqrt{\frac{1}{2} \omega_2 \sigma_{v_2}^2 + \frac{1}{2} \omega_2 \sigma_{m_2}^2 + \sigma_{q_2}^2}} \quad (A.14)$$

The ex ante expected profit of the insider from trading in period 2 is

$$E(\pi_2) = \frac{1}{4 \lambda_2} \sigma_{v_2}^2 - \frac{1}{2} \omega_2 \sigma_{v_2}^2 + \frac{1}{4} \lambda_2 \omega_2^2 (\sigma_{v_2}^2 + \sigma_{m_2}^2) + \frac{1}{4} \lambda_2 \phi^2 \delta^2 \quad (A.15)$$
References


Lakhal F., 2003 , Ear ning Voluntary D isclosures and Co rporate Governance: Ev idence f rom Fr ance, working paper.


