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Abstract

This paper examines the effects of mandatory disclosure information on unobservable precision choices by management of voluntary disclosure. Prior research articles investigate the precision of information disclosed by management, but they do not consider the relationships between mandatory and voluntary disclosure information. In this paper, I focus on the relationships and analyze precision choices under the situation that there are mandatory and voluntary disclosure. I find that mandatory disclosure information influences precision choices of voluntary disclosure.

Key words: Mandatory Disclosure; Voluntary Disclosure; Unobservable; Precision choice; Relationship

JEL Classification: M41; M48

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1 Introduction

Since accounting standards do not require firms to disclose full information, they disclose only a part of it. However, I can easily consider that the information which is not disclosed is useful for investors to make a decision. Thus, voluntary disclosure is one of the important fields in accounting, and there are many researches about voluntary disclosure.[1] On the other hand, there are researches about precision of information disclosed by management. It is difficult for outsiders to verify the precision of the information, because there is not a distinct criteria about the precision. If investors cannot verify the precision, it is probable that they cannot estimate the firm value properly. Therefore, it is important to study the precision of disclosed information.

Thus, there are some researches about precision of mandatory disclosure information but there is no research, to my best knowledge, about the precision of voluntary disclosure by management. I consider that the research is a very important research area, because there are no regulations of voluntary disclosure by management. Subramanyam (1996) examines the market reaction to information when the information precision is uncertain and exogenous. Penno (1996) investigates precision choices by management in financial reporting when the precision choices are endogenous and unobservable. This shows that the precision choices depend on prior information in financial reporting. It is natural to assume that the precision is endogenous and unobservable, because the management understand the cost of gathering and disclosing information.[2] Thus, I focus on the precision

[1] There are many researches that study firm's voluntary disclosure. Verrecchia (2001) and Dye (2001), for example, investigate voluntary disclosure comprehensively.

[2] Hughes and Pae (2004) assume that the precision of mandatory disclosure is exogenous and private information of the management. They examine the decision of disclosing the information by the management.

of voluntary disclosure information, assuming the precision is endogenous and unobservable.

Most literatures about voluntary disclosure focus on the decision of whether or not disclosing information, but there are few literatures which examine the decision under the situation that there are both mandatory and voluntary disclosure. I consider that the reason is that the two disclosure schemes are not interdependent. While firms are even more required to disclose additional information by accounting regulation, firms voluntarily disclose information more and more. Einhorn (2005) studies the management disclosure decision with and without disclosure regulation.[3] This research shows that the number of firms which disclose information voluntarily becomes larger when there is a disclosure regulation. This is because mandatory disclosure information and voluntary disclosure are not alternative but complementary. Therefore, prior researches which do not consider the relation have the weak implication to accounting standard-setting bodies.

Prior researches which examine the precision of disclosed information do not take into account the relation between mandatory disclosure and voluntary disclosure. Therefore, I extend the basic precision model examined by Penno (1996) to take into account the relationships between mandatory disclosure information and voluntary disclosure information. Assuming that the management chooses the precision of voluntary disclosure information, I introduce mandatory disclosure information exogenously to the model.

The main contribution of this paper is to provide a theoretical framework of unobservable precision choices under the situation that there are mandatory and voluntary disclosure. This paper explains that the precision by the management is

[3]Bagnoli and Watts (2007) also examines the management disclosure decision under the situation that there are mandatory disclosure and voluntary disclosure information. They assume that the two information are complementary.

determined by mandatory information required by the regulations and prior information about the contents of voluntary disclosure information. When both these information and mandatory are good news or bad news, I get similar result to the prior research. That is, the precision choices mainly depend on the prior information (good news or bad news). On the other hand, when the two information are different respectively (e.g., one is good news, the other is bad news), the precision choices are determined by both mandatory information and the prior information. This shows that the role of mandatory disclosure varies by the quality of the prior information of voluntary disclosure information.

The rest of this paper is organized as follows. Section 2 presents the model. Section 3 presents the result. Section 4 presents the conclusion.

2 The model

This model is an extension of Penno's (1996) unobservable precision choices model. While Penno's(1996) model assumes there is only one public signal, I assume that there are two public information, where one is media information and the other is mandatory information. I assume a risk-neutral market. My model considers management who chooses precision of voluntary disclosure information to maximize expected end-of-period firm value. After observing the two public signals, the management chooses precision of voluntary disclosure information, which is unobservable for investors. These signals are credibly disclosed, and investors (the market) use all the public information to price the firm at expected value.

Next, I explain the timeline.I consider five steps in this model. The value of the firm is $\tilde{V}$, which is a random variable and normally distributed with mean μ and variance σ_V^2, i.e., $\tilde{V} \sim N(\mu, \sigma_V^2)$. In the first step , media information is publicly

observed, denoted by $\tilde{z}$.

In the second step, mandatory disclosure information is publicly observed, designated by $\tilde{s}$, where $\tilde{s} = \delta\tilde{V} + \tilde{\theta}$. The variable $\tilde{\theta}$ is identically independent and normally distributed, with zero mean and variance σ_θ^2, i.e., $\tilde{\theta} \sim N(0, \sigma_\theta^2)$. Here, δ is a variable that represents how much information of the firm value is included in mandatory disclosure information, i.e., $\delta \in [0, 1]$. This means that mandatory disclosure information is a part of the firm's value, and white noise.

In the third step, the management privately chooses the precision ρ of voluntary disclosure information, after observing media information and mandatory disclosure information. The precision variable $\rho \in [\rho_L, \rho_H]$, $0 < \rho_L < \rho_H$ is a continuous choice variable by the management, and the cost of precision choices can be represented as $c\rho$, where $c > 0$. Thus, the value of the firm after choosing precision is $\tilde{V} - c\rho$.

In the fourth step, voluntary disclosure information $\tilde{t}$. The voluntary disclosure information of the firm value is represented as $t(\rho) = (1 - \delta)V + \varepsilon_\rho - c\rho$, where ε_ρ is identically independent and normally distributed, with mean zero and precision $1/\rho$. That is, voluntary disclosure information consists of a part of the firm value which is not included in mandatory disclosure information, noise based on precision by the management, and the precision cost,

In the fifth step, investors (the market) price this firm at it's expected value conditional on the prior information. That is, the price of the firm is equal to conditional expected value of the firm value after choosing precision, $P = E[V - c\rho | z, s, t(\rho)]$.

I adopt Penno (1996) approach. That is, "media information is a garbling of the least informative information". When choosing ρ' and ρ'' ($\rho_L \leq \rho' < \rho'' \leq \rho_H$) , I assume that there exists a random variable $\tilde{\lambda}$ such that:

$$\tilde{t}(\rho') + c\rho' = \tilde{t}(\rho'') + c\rho'' + \tilde{\lambda}$$

where $\tilde{\lambda}$ is an identically independent and normal random variable with mean zero. This means that $\tilde{t}(\rho') + c\rho'$ is a garbling of $\tilde{t}(\rho'') + c\rho'$. Thus, we can represent that $z = t(\rho_L) + c\rho_L + \psi = (1-\delta)\tilde{V} + \varepsilon_{\rho_L} + \tilde{\psi}$, where $\tilde{\psi}$ is an identically independent and normally distributed white noise term with mean zero i.e.,$\tilde{\psi} \sim N(0, \sigma^2_{\psi})$. So, $\tilde{z}$ is normally distributed with a μ mean and variance $\sigma^2_z = \sigma^2_V + \sigma^2_{\rho_L} + \sigma^2_{\psi}$.

3 Results

3.1 Basic case

The price of the firm $P(s,t,z)$ is represented by equation (1).[4] The management chooses the precision of voluntary disclosure to maximize the expected value of the firm value at the third step. The expected value of the firm value is represented by equation (2) . Therefore, the management maximizes the expected value of the firm price conditional on media information and mandatory disclosure information ($E[\tilde{P}(s,\tilde{t},z)|z,s]$).[5]

$$P(s,t,z) = E[V - c\rho|z,s,t(\rho)]$$

$$= E[\tilde{V} - c\rho] + \frac{Cov(\tilde{V} - c\rho, \tilde{s}) - \frac{Cov(\tilde{V}-c\rho,\tilde{t})Cov(\tilde{s},\tilde{t})}{Var(\tilde{t})}}{Var(\tilde{s}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{t})}}(s - E(\tilde{s}))$$

$$+ \frac{Cov(\tilde{V} - c\rho, \tilde{t}) - \frac{Cov(\tilde{V}-c\rho,\tilde{s})Cov(\tilde{s},\tilde{t})}{Var(\tilde{s})}}{Var(\tilde{t}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{s})}}(t - E(\tilde{t})) \quad (1)$$

[4]See the appendix.

[5]See the appendix.

$$E[\tilde{P}(s,\tilde{t},z)|z,s] = E[E[[\tilde{V} - c\rho|s,t(\rho),z]|z,s]$$

$$= E[\tilde{V} - c\rho] + \frac{Cov(\tilde{V} - c\rho,\tilde{s}) - \frac{Cov(\tilde{V}-c\rho,\tilde{t})Cov(\tilde{s},\tilde{t})}{Var(\tilde{t})}}{Var(\tilde{s}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{t})}}(s - E(\tilde{s}))$$

$$+ \frac{Cov(\tilde{V} - c\rho,\tilde{t}) - \frac{Cov(\tilde{V}-c\rho,\tilde{s})Cov(\tilde{s},\tilde{t})}{Var(\tilde{s})}}{Var(\tilde{t}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{s})}}(E(\tilde{t}|s,z) - (1-\delta)\mu + c\rho^M(s,z)) \tag{2}$$

There exists one Nash equilibrium, where the management chooses the precision to maximize the expected value. Let ρ^* be such that the management chooses to maximize the object function. Furthermore, let ρ^{FB} be such that management choose to maximize without precision constraints.[6] From the assumption, the precision choices by management are unobservable, so the market conjecture the precision. The market conjecture is denoted by ρ^M. This model provides a unique equilibrium. The equilibrium depends on the realized value of the media information and mandatory disclosure information. Here, I define the realized value of the information that is higher than the mean of the information as "Good news", and the realized value of the information that is lower than the mean of the information as "Bad news". If both the media information and mandatory disclosure information are Good news or Bad news, I call them "same direction", otherwise "different direction".

[6]The precision which mamize the object function without constraints is

$$\rho^{FB} = \sqrt{\frac{Var(\tilde{s})(z - E(z)) - Cov(\tilde{s},\tilde{z})(s - E(s))}{\{(Cov(\tilde{s},\tilde{z})^2 - Var(\tilde{z})Var(\tilde{s})\}c}}.$$

The detail of this is in appendix.

3.1.1 Different direction of the media information and mandatory disclosure information

Here, I show the precision choices by the management in the case of different direction of media information and mandatory disclosure information, In this case, we obtain the similar results of the prior research. In particular, the precision choices by the management are same of the prior research., when the value of media information is Good news ($z > E(z)$).

PROPOSITION 1

(1) When the value of media information is Bad news ($z < E(z)$), the equilibrium precision strategy by management is

$$\rho^* = \begin{cases} \rho_L & , \text{if } \rho^{FB} \leq \rho_L < \rho_H \\ \rho^{FB} & , \text{if } \rho_L < \rho^{FB} < \rho_H \\ \rho_H & , \text{if } \rho_L < \rho_H \leq \rho^{FB} \end{cases} .$$

In this case, the object function is shown in figure1.

(2) When the value of media information is Good news ($z > E(z)$), the equilibrium precision strategy by management is

$$\rho^* = \rho_L.$$

In this case, the object function is shown in figure2.

In the case of (1), the management expects that the low realized value of the media information is realized by a noise term.

On the other hand, in the case of (2), mandatory disclosure information does not influence the precision choices by management. The management expects that the low value of the information realized. If the management chose high precision, it would be likely that the lower value of voluntary disclosure information is realized. Therefore the management chooses the lowest precision.

3.1.2 Same direction of the media information and mandatory disclosure information

Here, I show the precision choices by management in the case of same the directions. I show that the precision choices by management is dependent on the value of both media information and mandatory disclosure information.

PROPOSITION 2

When the value of media information is lower than the expected value of the media information conditional on mandatory disclosure ($z < E[z|s]$), the equilibrium precision strategy by management is

$$\rho^* = \begin{cases} \rho_L & , \text{if } \rho^{FB} \leq \rho_L < \rho_H \\ \rho^{FB} & , \text{if } \rho_L < \rho^{FB} < \rho_H \\ \rho_H & , \text{if } \rho_L < \rho_H \leq \rho^{FB} \end{cases} .$$

In this case, the object function is shown in figure1.

When the value of media information is higher than the expected value of the media information conditional on mandatory disclosure ($z > E[z|s]$), the equilibrium precision strategy by management is

$$\rho^* = \rho_L.$$

In this case, the object function is shown in figure2.

Thus, the precision choice by management is affected by the value of mandatory disclosure information in these cases. This is because that the management can not find the cause of the value of media information. That is, the observed value of media information is realized by whether the firm value or noises. So, the management would find the cause by using the value of mandatory disclosure information. When the value of media information is lower than the expected value of the information conditional on mandatory disclosure, the management considers that the low value of the information is realized by a noise term.

On the other hand, when the value of media information is higher than the expected value of the information conditional on mandatory disclosure information, the management considers that the high value of the information realized by noises. Therefore, the management does not choose the high precision.

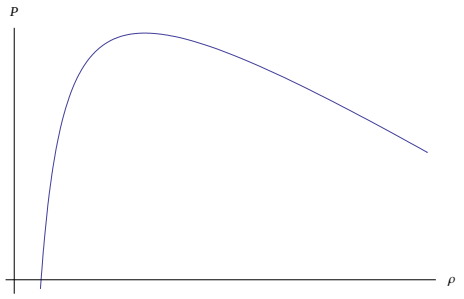

Figure 1: case(1)

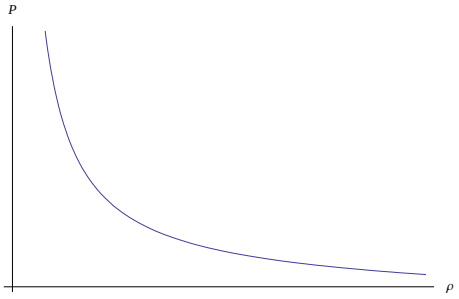

Figure 2: case(2)

3.2 Particular case

In this section, we examine the precision choices by management, when precision cost is zero ($c = 0$). The aim of this section is to show when the management has an incentive to choose high precision.

PROPOSITION 3

(3) When the realized value of media information is higher than the expected value of the media information conditional on mandatory disclosure information($E[z|s] < z$), the management chooses the lowest precision.

$$\rho^* = \rho_L$$

In this case, the object function is shown in figure3.

(4) When the realized value of media information is lower than the expected value of the media information conditional on mandatory disclosure information($E[z|s] > z$), the management chooses the highest precision (ρ_H).

$$\rho^* = \rho_H$$

In this case, the object function is shown in figure4.

Thus, the precision choices by management depend on whether the value of the media information is higher or lower than the expected value of the information conditional on the value of mandatory disclosure information. When the value of media information is higher than the expected value of the information conditional on mandatory disclosure information ($E[z|s] < z$), management does not have a incentive to choose high precision, because the object function decreases in precision. When the value of media information is lower than the expected value of the information conditional on mandatory disclosure information ($E[z|s] > z$), management has a incentive to choose high precision, because the object function increases in precision.

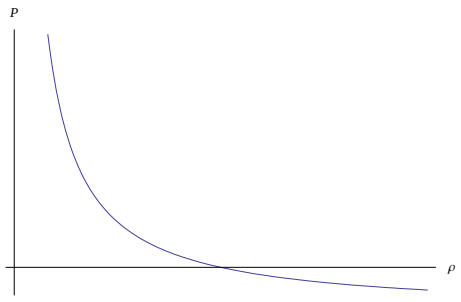

Figure 3: case(3)

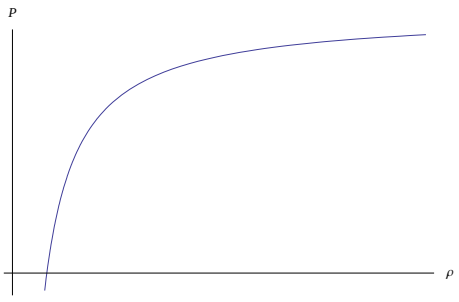

Figure 4: case(4)

4 Conclusion

This paper provides an extension model of the basic precision model. Assuming that the management chooses the precision of voluntary disclosure information, I introduce mandatory disclosure information to the model. This paper examines the influence of mandatory disclosure information on the precision choices by management. I observe that mandatory disclosure information has influence on the precision choices. In particular, I focus on the incentives of precision choices by management. When the two public information (media and mandatory) are in different directions (Good or Bad), I observe the similar results of the prior research. In this case, the incentive of precision choices depends on the direction of media information. However, I observe different results, when the two public information are in the same direction. That is, the incentive depends not only on the direction of media information but also on the direction of mandatory disclosure information.

This research contributes to accounting standard-setting bodies, because it offers a theoretical framework of unobservable precision choices under the situation that there are both mandatory and voluntary disclosure. It is more natural to assume that the precision is endogenous and unobservable under the situation. Thus, I consider that my model can be applied to various contexts.

However, there is room for improvement. The property of mandatory disclosure is exogenous, but I can not observe the influence of incentive change on the market in this model. This is a topic for my future research.

APPENDIX A

The price of the firm

This appendix provides price function. The price of the firm is equal to conditional expected value of the firm value after choosing precision. Thus, the price function is

$$P(s,t,z) = E[V - c\rho|z,s,t(\rho)]$$

$$= E[\tilde{V} - c\rho] + \frac{Cov(\tilde{V} - c\rho,\tilde{s}) - \frac{Cov(\tilde{V}-c\rho,\tilde{t})Cov(\tilde{s},\tilde{t})}{Var(\tilde{t})}}{Var(\tilde{s}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{t})}}(s - E(\tilde{s}))$$

$$+ \frac{Cov(\tilde{V} - c\rho,\tilde{t}) - \frac{Cov(\tilde{V}-c\rho,\tilde{s})Cov(\tilde{s},\tilde{t})}{Var(\tilde{s})}}{Var(\tilde{t}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{s})}}(t - E(\tilde{t})).$$

The expected value of this price of the firm

The expected value of this price of the firm is equal to conditional expected value of the firm value before voluntary disclosure information is disclosed. That is, the expected value of this price of the firm is the expected value of the firm price conditional on media information and mandatory disclosure information.

$$E[\tilde{P}(s,\tilde{t})|z,s] = E[E[[\tilde{V} - c\rho|z,,t(\rho)]|z,s]$$

$$= E[\tilde{V} - c\rho] + \frac{Cov(\tilde{V} - c\rho,\tilde{s}) - \frac{Cov(\tilde{V}-c\rho,\tilde{t})Cov(\tilde{s},\tilde{t})}{Var(\tilde{t})}}{Var(\tilde{s}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{t})}}(s - E(\tilde{s}))$$

$$+ \frac{Cov(\tilde{V} - c\rho,\tilde{t}) - \frac{Cov(\tilde{V}-c\rho,\tilde{s})Cov(\tilde{s},\tilde{t})}{Var(\tilde{s})}}{Var(\tilde{t}) - \frac{(Cov(\tilde{s},\tilde{t}))^2}{Var(\tilde{s})}}(E(\tilde{t}|s,z) - (1-\delta)\mu + c\rho^M(s,z))$$

The precision which maximize the object function without constraints

From above results, to maximize the object function is equal to maximizing the expected value of the voluntary disclosure information conditional on media information and voluntary disclosure information ($E[\tilde{t}|s,z]$).

$E[\tilde{t}|s,z]$

$$= E[\tilde{t}] + \frac{Cov(\tilde{t},\tilde{s}) - \frac{Cov(\tilde{t},\tilde{z})Cov(\tilde{s},\tilde{z})}{Var(\tilde{t})}}{Var(\tilde{s}) - \frac{(Cov(\tilde{s},\tilde{z}))^2}{Var(\tilde{z})}}(s - E(\tilde{s})) + \frac{Cov(\tilde{t},\tilde{z}) - \frac{Cov(\tilde{t},\tilde{s})Cov(\tilde{s},\tilde{z})}{Var(\tilde{s})}}{Var(\tilde{z}) - \frac{(Cov(\tilde{s},\tilde{z}))^2}{Var(\tilde{s})}}(z - E(z))$$

$$= (1-\delta)\mu + \frac{Var(\tilde{s})(z - E(z)) - Cov(\tilde{s},\tilde{z})(s - E(s))}{Var(\tilde{z})Var(\tilde{s}) - (Cov(\tilde{s},\tilde{z})^2}\frac{1}{\rho} - c\rho$$

$$+ \frac{Var(\tilde{s})(z - E(z)) - Cov(\tilde{s},\tilde{z})(s - E(s))}{Var(\tilde{z})Var(\tilde{s}) - (Cov(\tilde{s},\tilde{z})^2}[(1-\delta)^2 + \delta(1-\delta)]\sigma_V^2$$

$$= (1-\delta)\mu + \alpha\frac{1}{\rho} - c\rho + \alpha\delta(1-\delta)]\sigma_V^2,$$

$$\text{where} \quad \alpha = \frac{Var(\tilde{s})(z - E(z)) - Cov(\tilde{s},\tilde{z})(s - E(s))}{Var(\tilde{z})Var(\tilde{s}) - (Cov(\tilde{s},\tilde{z})^2}$$

Thus, the expected value of the voluntary disclosure information conditional on media information and voluntary disclosure information ($E[\tilde{t}|s,z]$) is a function of the precision by management. When the $\alpha > 0$, there exists the precision that maximize the function. So, the precision which maximize the object function without constraints is

$$\rho^{FB} = \sqrt{\frac{Var(\tilde{s})(z - E(z)) - Cov(\tilde{s},\tilde{z})(s - E(s))}{\{(Cov(\tilde{s},\tilde{z})^2 - Var(\tilde{z})Var(\tilde{s})\}c}}\ .$$

Table 1: Main notations

variable		
$\tilde{V}$	firm value	$\tilde{V} \sim N(\mu, \sigma_V^2)$
$\tilde{\theta}$	white noise	$\tilde{\theta} \sim N(0, \sigma_\theta^2)$
δ	the weight	$\delta \in [0,1]$
ρ	precision by management	$0 < \rho_L \leq \rho \leq \rho_H$
$\tilde{\varepsilon}_\rho$	controllable noise	$\tilde{\varepsilon}_\rho \sim N(0, 1/\rho)$
$\tilde{z}$	media information	$(1-\delta)\tilde{V} + \varepsilon_{\rho_L} + \tilde{\psi}$
$\tilde{s}$	mandatory disclosure information	$\delta\tilde{V} + \tilde{\theta}$
$\tilde{t}$	voluntary disclosure information	$(1-\delta)\tilde{V} + \tilde{\varepsilon}_\rho - c\rho$

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