

Strategic Commitment and Lying: An Experimental Study on the Interaction between Entrepreneur and Underwriter

Abstract

The objective of this paper is to answer the problem “When and how do people choose to lie?” through introducing strategic commitment by potential liars. In order to consider the role of commitment, we focus on an IPO setting and examine the interaction between an entrepreneur and an underwriter. Our theoretical and experimental findings suggest that the entrepreneur uses the ownership retention as a signal of commitment and manages earnings upward. In addition, given that the entrepreneur retains ownership, the underwriter optimistically assesses the reported earnings.

Keywords: IPO; earnings management; commitment; white lies; experiment

JEL Classification: D74; G02; M41

1 Introduction

The objective of this paper is to investigate the relationship between strategic commitment and lying. Numerous experimental studies consider lying behaviors in different economic environments and report that people have a tendency toward lying aversion (e.g., Gneezy, 2005; Hurkens and Kartik, 2009; Lundquist et al., 2009; Sanchez-Pages et al., 2009; Erat and Gneezy, 2012; Gibson et al., 2013; Gneezy et al., 2013; Lopez-Perez and Spiegelman, 2013). That is, people often tell the truth even if they can increase their material payoffs by lying. This suggests that people are more honest than is predicted by the traditional economic theories, which is based on the *homo economicus* assumption. Nonetheless casual observations suggest that dishonest behaviors are frequently found in some economic settings. Accounting frauds, such as window-dressing and tax evasion, are typical examples. So when and how do people choose to lie?

One of the factors which might affect whether people tell lies or not is the consequential outcomes for *both* the liar and the other. Gneezy (2005) argues that people care about not only their own gains from lying; they also take into account their partners' payoffs. Erat and Gneezy (2012) classify the four types of lies by the consequential outcomes from lying. (i) Selfish black lies: liars can increase their own payoffs but partners suffer losses, (ii) spiteful black lies: both liars and partners incur losses, (iii) altruistic white lies: liars incur losses but partners' payoffs increase, (iv) Pareto white lies: both liars and partners benefit from lying. In addition, the experimental data of Erat and Gneezy (2012) suggests

that people lie more frequently in the situation of “Pareto white lie” compared with the situation such as “selfish black lie” and “altruistic white lie.”

This paper answers the problem “When and how do people choose to lie?” through introducing strategic commitment by potential liars. In order to examine the role of commitment, we focus on a specific economic setting where an entrepreneur is filing for an initial public offering (IPO). More specifically, we consider the situation where an entrepreneur (IPO firm) issues new shares and reports earnings, and then an underwriter assesses the earnings and sets the offering price.

In IPO research, two major problems are well-known as ‘IPO puzzles.’ First, in the short-run, it is observed that the first listing price of an IPO firm is much higher than the offering price set by the underwriter (Ibbotson, 1975; Ritter, 1984; Loughran and Ritter, 1995; Loughran and Ritter, 2002; Ritter and Welch, 2002; Loughran and Ritter, 2004). The difference between them is so-called ‘money left on the table.’ Second, it is also observed that in the long-run the share price becomes much lower than the offering price (Aggarwal and Rivoli 1990; Ritter, 1991; Loughran and Ritter, 1995; Ritter and Welch, 2002). That is often called ‘long-run underperformance.’

It leads to a question ‘which is the fundamental value, the first listing price or the offering price?’ There are two main streams of research to answer the question. First, according to the traditional theories assuming that investors have homogeneous expectation (Markowitz, 1952; Sharpe, 1964; Lintner, 1965; Black and Scholes, 1973), it is argued that the first listing price is the fundamental value.

Hence the difference between them is ‘underpricing’ in that the IPO firm was underpriced by the underwriter. Second, according to the behavioral theories assuming that there is a divergence of opinions among investors (Miller, 1977; Shleifer, 1986; Chen, Hong, and Stein, 2002; Chatterjee, John, and Yan, 2012), it is argued that the offering price is the fundamental value. Hence the difference between them can be interpreted as investors’ sentiment bubble.

Our research differs from both the traditional theories and the behavioral theories in that neither the first listing price nor the offering price is the fundamental value. That makes us possible to explain why the IPO puzzles coexist.

Assuming that there is a divergence of opinions among investors, we have a conclusion that even the offering price is distorted through collusion between the entrepreneur and the underwriter. That is, the offering price is already “overpriced.” Therefore the difference between the first listing price and the offering price represents investors’ sentiment bubble, and hence the share price will go down seriously as asymmetry of information between both the entrepreneur and the underwriter and investors is mitigated after the IPO. That delivers the long-run underperformance.

Our IPO context has some interesting features. First, according to Miller (1977), we assume that there is a divergence of investors’ opinions, and hence the demand curve of the share is downsloping to right. That is a sharp contrast to the traditional theories.¹ Second, capital market perceives a higher ownership

¹In the traditional theories (e.g. Sharpe (1964) and Lintner (1965)), there are no divergences of investor’s opinions, and hence the demand curve is flat.

retention of the entrepreneur as good news. Namely, the demand curve shifts upward as the level of the retained ownership increases.² The settings make us possible to explore the interactive mechanism of the demand and the supply.

In general, the entrepreneur prefers a higher offering price because she wants to obtain enough capital to expand her business or realize the founder's profit. Therefore, the entrepreneur might have an incentive to overstate earnings in order to pretend that the firm has good performance and have the offering price raised.

To some extent, the underwriter and the entrepreneur share mutual interests. Since the underwriting fee generally increases in the capital raised, the underwriter might benefit from the higher offering price. However, the underwriter must also bear the risk. If the offering price is too high for the shares to be sold out in the market, the underwriter will absorb the loss due to the unsold shares. This might lead the underwriter to assess the reported earnings strictly and set the offering price lower in order to avoid the risk.³ That is, when the demand for the shares is relatively low and the risk of loss due to the unsold shares is relatively high, there is a conflict of interest between the entrepreneur and the underwriter.

We model the potential conflict situation above and conduct an experiment in order to test the theoretical predictions. Basically, an experimental approach has several advantages in testing them. First, researchers can freely create a controlled economic environment that corresponds to the timeline and the information set

²This assumption is consistent with the empirical finding of Fan (2007) that ownership retention is positively related to valuation of IPO firms.

³See, for example, Baron (1982), Chen and Mohan (2002), and Deloof et al. (2008). In particular, Deloof et al. (2008) argues that the final offering price is decided taking into account current market conditions.

of the model. Second, researchers can directly observe people's behaviors and collect behavioral and psychological data. These characteristics make us possible to directly verify the model.

Our theoretical and experimental findings are summarized as follows. First, the entrepreneur increases the level of ownership retention *and* overstates earnings to have the offering price raised. Second, the underwriter overlooks the distorted earnings and quote a higher offering price especially in the case of a sufficiently high level of the ownership retention.⁴ This is because, given that investors perceive the higher ownership retention as good news, it increases the market demand for the shares. Therefore, the underwriter can reduce the risk of incurring loss due to the unsold shares even if he sets the higher offering price. In other words, the ownership retention works as a signal of commitment so that the interests of the entrepreneur and the underwriter are aligned. In this situation, *both* the entrepreneur and the underwriter can benefit from overstating the earnings and setting the offering price "overpriced."

This paper has several contributions to the academic research. First, to the best of our knowledge, this is the first paper that argues IPO firms are "overpriced." We develop a theoretical model on the collusion between the entrepreneur and the underwriter in an IPO setting on the assumption that there is a divergence of opinions among investors and that the higher retention is perceived as good news by them. The collusion is a typical example of 'Pareto white lie' situation. Our

⁴In the model, the offering price is an increasing function of ownership retention and earnings *after* the assessment by the underwriter. The details of the model will be described in Section 2.

conclusion is a sharp contrast to those of prior research that argues IPO firms are underpriced. Therefore, this paper could offer a new insight to the IPO research.

Second, the intense interest has recently focused on the question of when and how people lie. We develop a theoretical model in IPO settings and examine the predictions of the model by laboratory experiment. Because IPOs are big business events that attract attention of many business people (e.g. investors, underwriters, regulatory agencies and so on), our paper makes some contribution to business by suggesting a clue to when and how people lie.

Third, the traditional theories assume that investors have homogeneous expectation and hence the demand curve is flat. However that is an unrealistic premise because it is hard to believe that investors have the same opinion about security prices in an uncertain world. Therefore we develop the model on the assumption that there is a divergence of investors' opinions, and hence the demand curve is downsloping to right. This enables us to develop the plausible model that explains reality.

Fourth, this paper provides a new insight into the literature by examining the role of commitment. Trueman (1986) assumes the information asymmetry between an entrepreneur and investors, and developed a model that she uses capital investment and the ownership retention as signals in IPO settings. In our settings, the level of ownership retained by the entrepreneur (potential liar) works as a signal of commitment and can change the underwriter's behavior so that both the entrepreneur and the underwriter share mutual interests. This implies that, in the framework of Erat and Gneezy (2012), the entrepreneur can change the situation

of “selfish black lie” into that of “Pareto white lie” by raising the level of commitment. Our results suggest that people strategically create the situation of “Pareto white lie” by means of commitment *and* lie.⁵

Finally, this paper also relates the experimental studies about IPOs and earnings management. In accounting, Mayhew et al. (2004) examine the retained ownership as a signaling device in IPO. In their experiment which is based on Datar et al. (1991) model, however, earnings management is not addressed. Other studies explore the IPO auction mechanism. Zhang (2009) compares fixed price offerings with uniform price auction. Almeida and Leal (2011) examine three IPO pricing methods, namely book building, the Dutch clock auction, and the competitive method. On the other hand, there are several experimental studies which examine earnings management in various settings but not IPO contexts. Hirst and Hopkins (1998) and Maines and McDaniel (2000) investigate the effect of disclosure format of comprehensive income on investors’ ability to detect earnings management and their judgments about the firm performance. Tan and Jamal (2006) examine whether managers smooth earnings through real discretion when accounting discretion reduces. Some other studies focus on the relationship between earnings management and audit. For example, Hirst (1994) examine auditors’ judgments about the probability that a material misstatement exists in contexts of a management buyout and earnings-based compensation plans. In their recent study, Chen et al. (2012) investigate the effects of changes in auditors’

⁵In this paper, the term “Pareto white lie” is used in the sense that both players in the game benefit from lying. To discuss social welfare is beyond the scope of this paper.

actions on the deterrence of earnings management. To the best of our knowledge, this paper is in experimental studies the first that investigates both the ownership retention and the earnings management in the setting of IPO. Therefore, this paper can provide the possible explanation to the relationship between ownership retention and earnings management in IPO.

The remainder of this paper is organized as follows. In section 2, we develop the theoretical model which provides the basis for experimental tests. Section 3 describes the experimental design and Section 4 reports the results. In section 5, we extend the model by introducing earnings management costs. Section 6 summarizes the paper.

2 Model

2.1 Settings of the model

We have a two-period model. In the first period (hereafter ‘period 0’), a risk-neutral entrepreneur who owns all of the firm’s shares (N shares) decides to have the firm go public at the beginning of the second period (hereafter, ‘period 1’). At the IPO, she issues another N shares and sell $S = (1 - w)N$ shares that she owns ($0 \leq w \leq 1$).

Since her payoff by selling the shares increases in the public offering price P_0 decided by an underwriter, she has an incentive to raise it by managing earnings in financial statements she issues at the end of period 0. Let θ and μ be the true earnings and an amount of the earnings management in period 0 respectively. The

reported earnings e can be written as

$$e = \theta + \mu.$$

We assume that $0 \leq \mu \leq \theta$, that is $\theta \leq e \leq 2\theta$.

The firm has business activities in period 1. The probability of its success is p ($0 < p < 1$) and in case of the success the share price will go up to $P_1 = P_0 + \alpha$ ($\alpha > 0$) at the end of period 1. However there is a risk that the earnings management comes to light. We assume the probability is q ($0 < q < 1$). If it does, the share price will go down by $k\mu$ ($0 \leq k \leq 2$) in period 1⁶. In case of the business activities's failure (with the probability $1 - p$), the share price will go down to $P_1 = 0$ at the end of period 1 irrelevant of whether the earnings management comes to light or not.

Hence, the entrepreneur maximizes

$$\begin{aligned} & (1 - q)[P_0S + p(P_0 + \alpha)(N - S)] + q[P_0S + p(P_0 + \alpha - k\mu)(N - S)] \\ & = N \{ [1 - (1 - p)w]P_0 + wp(\alpha - q\mu k) \}. \end{aligned}$$

Since N is positive and constant, for simplicity we define her payoff as

$$U_e = [1 - (1 - p)w]P_0 + wp(\alpha - q\mu k).$$

⁶We assume $\alpha > k\mu$ to avoid the cases of $P_1 < 0$.

According to Miller(1977), we assume that there is a divergence of investors' opinions, and hence the demand curve of the share is downsloping to right shown in Figure 1⁷. Let a demand curve of the share be

$$P + D(P) = a + f(w)$$

where P and $D(P)$ are a share price and an inverse demand function of the share respectively. a represents a degree of popularity of the firm and we assume $a > 2N$ ⁸.

A higher ownership retention after the IPO is perceived as good news by investors because it is a signal that she may have private information about good prospects of the firm, and shifts the demand curve upward shown in Figure 1. That is,

$$f(0) = 0, \quad f(w)_{w \neq 0} > 0, \quad f'(w) > 0.$$

We assume that the marginal effect of the retention on w is decreasing, $f''(w) \leq 0$.

Insert Figure 1 about here.

Generally an underwriter's payoff increases in a product of an offering price and how many shares (Q) he sells in a market. Hence, we define the underwriter's

⁷In the traditional theories (eg. Sharpe(1964) and Lintner(1965)), there are no divergences of investor's opinions, and hence the demand curve is flat.

⁸This is a typical assumption about demand curves.

payoff as P_0Q for simplicity. It is clear that a higher offering price makes his payoff higher as long as the demand of the shares exceeds the supply in the market. However too high an offering price makes the excess supply and makes his payoff lower.

We assume that the underwriter decides the offering price considering two factors. The first is earnings in period 0. Since he cannot observe the true earnings but the reported earnings that might be managed by the entrepreneur, all he can do is to estimate it, in other words to estimate the earnings management. The larger estimated earnings management leads him to quote a lower offering price. The second is the owner's retention. Since he knows the higher ownership retention is perceived as good news by investors, it leads him to quote a higher offering price.

Hence we assume that he decides the offering price P_0 according to

$$P_0 = x + g(w) + e - \widehat{\mu} = x + g(w) + (\theta + \mu) - \widehat{\mu}$$

where $x(> 0)$, $\theta(> 0)$, and $\widehat{\mu}(\geq 0)$ are the firm value at the beginning of period 0, the true earnings in period 0, and the earnings management estimated by the underwriter respectively, and where $g(0) = 0$, $g(w)_{w \neq 0} > 0$, and $g'(w) > 0$. We further assume that $g'(w)$ is less than N ⁹ and the marginal effect of the retention on $g(w)$ is decreasing, $g''(w) \leq 0$.

⁹This assumption only implies that the curve $g(w)$ is not very steep in $0 \leq w \leq 1$.

Hence, the problem of the underwriter is to maximize U_u .

$$\begin{aligned}
U_u = P_0 Q &= \begin{cases} P_0(N + S) & \text{if } N + S \leq D(P_0) \\ P_0 D(P_0) & \text{otherwise} \end{cases} \\
&= \begin{cases} P_0(N + S) & \text{if } P_0 \leq a + f(w) - (N + S) \\ P_0(a + f(w) - P_0) & \text{otherwise} \end{cases} \\
&= \begin{cases} -(N + S)[\widehat{\mu} - (x + g(w) + e)] & \\ \text{if } \widehat{\mu} \geq x + g(w) - f(w) + e - a + N + S & \\ -[\widehat{\mu} - (x + g(w) + e)][\widehat{\mu} - (x + g(w) - f(w) + e - a)] & \\ \text{otherwise.} & \end{cases} .
\end{aligned}$$

Insert Figure 2 (a), (b) about here.

The intersections of $U_u = P_0(N + S)$ and $U_u = P_0 D(P_0)$ are $\widehat{\mu}_1 = x + g(w) - f(w) + e - a + (2 - w)N$ and $\widehat{\mu}_2 = x + g(w) + e$ shown in Figure 2¹⁰. It is important to note that the larger earnings management, the higher $\widehat{\mu}_1$ and that the higher retention, the lower $\widehat{\mu}_1$.

$$\frac{\partial \widehat{\mu}_1}{\partial \mu} = 1.$$

$$\frac{\partial \widehat{\mu}_1}{\partial w} = g'(w) - f'(w) - N < 0 \quad (f'(w) > 0, 0 < g'(w) < N).$$

We first solve the problem in a case without earnings management costs ($k =$

¹⁰In Figure 2, we assume that the axis of symmetry of U_u is greater than $\widehat{\mu}_1$. In Appendix A, we show why this assumption is appropriate.

0) for simplicity, since the implications are qualitatively same as in a case with the earnings management costs ($k > 0$). In the fifth section we show the solutions with the earnings management costs as an extension by comparing with the solutions without them.

2.2 Solutions without earnings management costs

We solve the problem by dividing it into three cases.

Case (I) A very popular firm with $a \geq x + 2\theta + 2N$

We call a firm with $a \geq x + 2\theta + 2N$ a ‘very popular firm’ in that even if the entrepreneur sells all the shares she owns ($w = 0$) and manages earnings to a maximum degree ($\mu = \theta$),

$$\widehat{\mu}_1|_{w=0, \mu=\theta} = x + 2\theta - a + 2N \leq 0.$$

Hence, the underwriter chooses $\widehat{\mu}^* = 0$ shown in Figure 2(a).

Since $P_0 = x + g(w) + \theta + \mu$,

$$U_e = \{1 - (1 - p)w\}(x + g(w) + \theta + \mu) + wp\alpha.$$

Since $\partial U_e / \partial \mu = 1 - (1 - p)w > 0$, the entrepreneur chooses $\mu^* = \theta$.

Hence, U_e can be written as

$$U_e = \{1 - (1 - p)w\}(x + g(w) + 2\theta) + wp\alpha.$$

$$\frac{dU_e}{dw} = p\alpha - (1 - p)\{g(w) + wg'(w) + x + 2\theta\} + g'(w) \equiv \phi_0^H(w).$$

Since $g'(w) > 0$, $g''(w) \leq 0$,

$$\frac{d^2U_e}{dw^2} = \frac{d\phi_0^H(w)}{dw} = -2(1 - p)g'(w) + \{1 - (1 - p)w\}g''(w) < 0.$$

Hence, $\phi_0^H(w)$ is a strictly decreasing function of w .

$$\begin{aligned} \frac{\partial \phi_0^H(w)}{\partial p} &= \alpha + g(w) + wg'(w) + x + 2\theta > 0. \\ \frac{\partial \phi_0^H(w)}{\partial \alpha} &= p > 0. \end{aligned}$$

Hence, the larger p and the larger α shift the curve $\phi_0^H(w)$ upward. Since $\phi_0^H(w)$ is a strictly decreasing function of w shown in Figure 3, the optimal retentions are as follows:

[A₀] When p and/or α are large enough to hold $\phi_0^H(1) \geq 0$, $w^* = 1$.

[B₀] When p and/or α are such that hold $\phi_0^H(1) < 0 < \phi_0^H(0)$, $0 < w^* < 1$.

[C₀] When p and/or α are small enough to hold $\phi_0^H(0) \leq 0$, $w^* = 0$.

Insert Figure 3 about here.

The implications of the solutions are twofold. First the entrepreneur whose firm is very popular to investors before the IPO manages earnings to the maximum degree because she knows the underwriter chooses to estimate zero earnings management. Second she nevertheless sells the shares when an expected loss from holding the shares is enough larger than an expected return from the business activities¹¹.

Case (II) An unpopular firm with $a < x + g(1) - f(1) + \theta + N$

We call a firm with $a < x + g(1) - f(1) + \theta + N$ an ‘unpopular firm’ in that even if the entrepreneur holds all the shares she owns ($w = 1$) and does not manage earnings at all ($\mu = 0$),

$$\widehat{\mu}_1|_{w=1, \mu=0} = x + g(1) - f(1) + \theta - a + N > 0.$$

Hence, the underwriter chooses $\widehat{\mu}^* = \widehat{\mu}_1$ shown in Figure 2(b).

Since $P_0 = x + g(w) + e - \widehat{\mu}^* = f(w) + (w - 2)N + a$,

$$U_e = \frac{\{1 - (1 - p)w\}\{f(w) + (w - 2)N + a\} + wp\alpha}{1} \quad (1)$$

¹¹The expected return from the business activities is $p\alpha$. Since the offering price when $w = 0$ is $P_0 = x + 2\theta$, the expected loss is $(1 - p)(x + 2\theta)$. In the extreme case that an expected loss is enough larger than an expected return, say $\phi_0^H(0) = p\alpha - (1 - p)(x + 2\theta) + g'(0) < 0$, the entrepreneur sells all the shares she owns.

This implies the entrepreneur's payoff is irrelevant of the reported earnings.
Hence, she chooses $\mu^* = \text{any}(0 \leq \mu^* \leq \theta)$.

$$\frac{dU_e}{dw} = -(1-p)\{f(w) + wf'(w) + 2(w-1)N + a\} + f'(w) + N + p\alpha \equiv \phi_0^L(w).$$

Since $f'(w) > 0$ and $f''(w) \leq 0$,

$$\frac{d^2U_e}{dw^2} = \frac{d\phi_0^L(w)}{dw} = -2(1-p)\{f'(w) + N\} + \{1 - (1-p)w\}f''(w) < 0.$$

Hence, $\phi_0^L(w)$ is a decreasing function of w .

$$\frac{\partial \phi_0^L(w)}{\partial p} = f(w) + wf'(w) + 2(w-1)N + a + \alpha > 0 \quad (a > 2N).$$

$$\frac{\partial \phi_0^L(w)}{\partial \alpha} = p > 0.$$

Hence, the larger p and the larger α shift the curve $\phi_0^L(w)$ upward. Since $\phi_0^L(w)$ is a decreasing function of w shown in Figure 4, the optimal retentions are as follows:

[a₀] When p and/or α are large enough to hold $\phi_0^L(1) \geq 0$, $w^* = 1$.

[b₀] When p and/or α are such that hold $\phi_0^L(1) < 0 < \phi_0^L(0)$, $0 < w^* < 1$.

[c₀] when p and/or α are small enough to hold $\phi_0^L(0) \leq 0$, $w^* = 0$.

Insert Figure 4 about here

The implications of the solutions are twofold. First the entrepreneur whose firm is unpopular to investors does not have an incentive to manage earnings, because the underwriter focuses only on the components of the demand function (w, a, N) and does not use the reported earnings when deciding the offering price. Second the entrepreneur nevertheless holds the shares when an expected return from the business activities is enough larger than an expected loss from holding the shares¹².

Case (III) For a firm with $x + g(1) - f(1) + \theta + N \leq a < x + 2\theta + 2N$

We call a firm neither very popular nor unpopular a ‘popular’ firm. We call it a ‘popular firm’. The sign of $\widehat{\mu}_1 = x + g(w) - f(w) + e - a + (2 - w)N$ can be either positive or negative depending μ and w .

We examine whether the entrepreneur can increase her payoff by raising the ownership retention. Suppose that for $w = w_1$, the underwriter chooses $\widehat{\mu}^* = \widehat{\mu}_1 > 0$ (hereafter ‘unpopular equilibrium’) and that for $w = w_2 \equiv w_1 + \Delta w$ ($\Delta w > 0$), he chooses $\widehat{\mu}^* = 0$ (hereafter ‘very popular equilibrium’). In the unpopular equilibrium,

$$U_e^1 = \{1 - (1 - p)w_1\}\{f(w_1) + (w_1 - 2)N + a\} + w_1p\alpha$$

¹²The expected return is $p\alpha$. Since the offering price when $w = 0$ is $P_0 = a - 2N$, the expected loss is $(1 - p)(a - 2N)$. When the expected return is enough larger than the expected loss, say $\phi_0^L(0) = -(1 - p)(a - 2N) + f'(0) + N + p\alpha > 0$, the entrepreneur holds some or all of the shares.

and in the very popular equilibrium,

$$U_e^2 = \{1 - (1 - p)w_2\}\{x + g(w_2) + 2\theta\} + w_2p\alpha.$$

The conditions that the entrepreneur can increase her payoff by raising the ownership retention are that in the very popular equilibrium she does not sell all the shares she owns¹³, in the unpopular equilibrium she does not hold all the shares she owns¹⁴, and her payoff increases from the change in the equilibriums. That is,

$$\phi_0^H(0) \equiv p\alpha - (1 - p)(x + 2\theta) + g'(0) > 0.$$

$$\phi_0^L(1) \equiv p\alpha + f'(1) + N - (1 - p)\{f(1) + f'(1) + a\} < 0.$$

$$\begin{aligned} U_e^2 &\equiv \{1 - (1 - p)w_2\}\{x + g(w_2) + 2\theta\} + w_2p\alpha \\ &> \{1 - (1 - p)w_1\}\{f(w_1) + (w_1 - 2)N + a\} + w_1p\alpha \equiv U_e^1. \end{aligned}$$

Insert Figure 5 about here.

The shadowed area in Figure 5 satisfies all the conditions above, and for any points (p, α) in the shadowed area, there exist w_1 and Δw ($\Delta w > 0$) that satisfy $0 \leq w_1 < w_2 = w_1 + \Delta w \leq 1$. The proof is provided in Appendix B.

Taken together, there exist some cases that the payoff of the entrepreneur can be increased through changing the underwriter's behavior by increasing the owner's retention. Hence, we have a proposition.

¹³This is equivalent to $[A_0]$ or $[B_0]$ in Case(I).

¹⁴This is equivalent to $[b_0]$ or $[c_0]$ in Case(II).

Proposition

Neither in a situation that p and/or α are not small enough for the entrepreneur in the very popular equilibrium to sell all the shares nor in a situation that p and/or α are not large enough for the entrepreneur in the unpopular equilibrium to hold all the shares,

1. the entrepreneur raises the ownership retention and manages earnings upward to a maximum degree, and
2. the underwriter chooses to estimate no earnings managements.

Since the entrepreneur knows that in a higher retention case it is optimal for the underwriter to decide the offering price assuming she does not manage earnings at all, she chooses the higher retention and the maximum level of earnings management. On the other hand, since the underwriter knows the higher retention is perceived as good news by investors, he chooses to estimate no earnings management as far as the demand of the share exceeds the supply. This is a collusion between the entrepreneur and the underwriter, and an typical example of Pareto white lie to investors.

In a real world, a firm that is going public can be thought neither a very popular firm nor an unpopular firm, the proposition can explain the strategic interaction between the entrepreneur and the underwriter. In the following section we examine the proposition by experiment.

3 Experimental Design

3.1 Experimental parameters and hypotheses

Based on the model analyzed in the previous section, we conduct an experiment in order to test the theoretical predictions. Since the implications in the case with the earnings management costs are qualitatively same as those without the costs, we conduct the experiment in the case of without them for simplicity. Especially, we consider the “popular” case in the model. In the experiment, participants take the role of either the entrepreneur or the underwriter. The entrepreneur is assumed to own a hundred of shares of her firm and plan to issue an additional a hundred of shares (i.e., $N = 100$). She chooses the level of ownership retention $w\%$ and reported earnings e . Then, the underwriter observes and assesses the reported earnings and chooses the corrected actual earnings, which is calculated by subtracting the underwriter’s estimation of earnings management from the reported earnings (i.e., $e - \widehat{\mu}$).

The experimental parameters are deliberately specified so that we can create the “popular” case in the model and the participants can easily understand the structure of the game. In particular, the parameters used in the experiment are as

follows.

Offering Price (P_0)

$$= 100 + 10 \times \text{Retention (}w\%) + \text{Corrected Actual Earnings (}e - \widehat{\mu}\text{)},$$

Demand

$$= -\text{Offering Price (}P_0\text{)} + 10 \times \text{Retention (}w\%) + 450,$$

Supply

$$= 100 + 100 \times (1 - \text{Retention (}w\%)),$$

Stock Dealings = min {Demand, Supply}.

For simplicity, we assume that the business activities of the firm achieve success with probability 75% and the share price will go up to $P_1 = P_0 + 100$. On the other hand, the business activities fail with probability 25% and the share price will go down to $P_1 = 0$. Therefore, the payoff for the entrepreneur is calculated as follows.

$$U_e = \text{Offering Price (}P_0\text{)} \times 100 \times (1 - \text{Retention (}w\%)) \\ + 0.75 \times (\text{Offering Price (}P_0\text{)} + 100) \times (\text{Retention (}w\%) \times 100).$$

The payoff for the underwriter does not depend on the success in business and is calculated as follows.

$$U_u = \text{Offering Price (}P_0\text{)} \times \text{Stock Dealings}.$$

When the entrepreneur chooses the reported earnings e , she can manage earnings upward. More specifically, nature selects the true earnings θ from the set $\{80, 100, 120\}$ and only the entrepreneur observes the realized one. Then, she chooses the reported earnings among (i) the true earnings (i.e., $e = \theta$), (ii) 1.5 times of the true earnings (i.e., $e = 1.5\theta$), and (iii) the double of the true earnings (i.e., $e = 2\theta$). This means that (i) when $e = \theta$, the earnings management $\mu = 0$, (ii) when $e = 1.5\theta$, $\mu = 0.5\theta$, (iii) when $e = 2\theta$, $\mu = \theta$. For example, if the true earnings is 100, then the entrepreneur chooses the reported earnings from the set $\{100, 150, 200\}$. Furthermore, she chooses the level of ownership retention $w\%$ from the set $\{0\%, 50\%, 100\%\}$.¹⁵

The underwriter observes the reported earnings e and the ownership retention $w\%$. He chooses the percentage from the set $\{0\%, 25\%, 50\%, 75\%, 100\%\}$ taking into account that the entrepreneur might manage earnings upward. For example, if the reported earnings is $e = 200$ and the underwriter chooses 75%, then the estimation of the earnings management $\widehat{\mu}$ is calculated as $(200 \times 0.75) = 150$. Thus, the corrected actual earnings ($e - \widehat{\mu}$) is $200 - 150 = 50$.

We focus on the “popular” case in the model. In this case, the conflict of interest between the entrepreneur and the underwriter might exist. This is because if the entrepreneur manages earnings upward and the resulting offering price becomes higher, then the underwriter might face the risk of incurring loss due to the unsold shares. Hence, the underwriter will have an incentive to assess the

¹⁵For ease of participants, the experiment requires them to choose an amount of shares which they sell.

reported earnings severely (i.e., lower the corrected actual earnings) and set the offering price lower.

The entrepreneur, however, can enhance the market demand for the shares by increasing the level of the ownership retention. This reduces the underwriter's risk and can alter the situation from "selfish black lie" to "Pareto white lie." In other words, if the entrepreneur retains the ownership higher, then earnings management might also become beneficial to the underwriter. In our experimental parameters, the probability of success in business is high enough for a risk-neutral entrepreneur to retain the ownership. Therefore, we expect that the entrepreneur uses the ownership retention as a signal of the commitment and manages the earnings upward. In addition, given that the entrepreneur retains ownership, we predict that the underwriter optimistically assesses the reported earnings because the higher offering price is beneficial for him. Taken together, the following hypotheses are tested.

Hypothesis 1 (the behavior of the entrepreneur) The entrepreneur increases the ownership retention *and* manages earnings upward.

Hypothesis 2 (the behavior of the underwriter) The underwriter optimistically assesses the reported earnings if the entrepreneur retains the ownership higher.

Note that Hypothesis 1 and Hypothesis 2 correspond to Proposition 1 and Proposition 2 in Section 2, respectively. Regarding Hypothesis 2, the conflict of interest between the entrepreneur and the underwriter is likely to arise in the

case where the reported earnings is above a certain level in our experimental parameters. Therefore, we expect that this relation between the assessment and the ownership retention becomes pronounced when the entrepreneur reports higher earnings.

3.2 Procedures

Following the experimental design discussed in the previous subsection, we ran two sessions with the same parameters. Upon arrival at the lab, participants were randomly assigned the role either the entrepreneur or the underwriter. The role was unchanged throughout the session. In the lab, the participants were assigned a computer screen and received a written instruction. Then, the experimenter read aloud the instruction and the participants answered quizzes in order to check the understanding of the game. The instruction used an economic frame because our experimental setting is somehow complicated. We believe that the participants can imagine the concrete situation which they face by appropriate framing. In addition, they can use both a payoff calculator and a payoff table in order to calculate their payoffs.

In all the sessions, we used the strategy method, in which participants make contingent decisions for all possible scenarios.¹⁶ In this method, first, participants make contingent choices for every possible decision node; then they are matched; and, finally, the appropriate choices are carried out for the nodes that are reached, and the other contingent choices are ignored (Casari and Cason, 2009, p.157).

¹⁶See Brandts and Charness (2011) for the review about the strategy method.

Casari and Cason (2009) argue that this method has several advantages. First, researchers can collect a large volume of data because participants make decisions for all possible situations. Second, compared to the standard game method, the strategy method elicits more careful decisions. Third, providing monetary compensations based on the final matched outcome gives financial incentives to the participants. This ensures a certain level of internal validity.

In the experiment, each participant used a computer to access the website designated to their assigned role and responded to all the possible cases under our experimental parameters stated in the previous subsection. In addition, participants whose roles were the entrepreneur were also required to answer their *expectations* about underwriters' estimations of earnings management, $E_e(\widehat{\mu})$, for each case. In a similar way, participants whose roles were the underwriter were required to answer their *expectations* about true earnings, $E_u(\theta)$, for each case. These additional data make the analysis of the experimental results in the following section richer.

4 Results

4.1 Outline

Participants were the total of twenty-five undergraduate students in a Japanese university. The average age of them was 19.5, the number of female was ten. The total of thirteen were the role of entrepreneur, and the total of twelve were the role of underwriter. The allocation of subjects to the roles was completely random. The average reward was 2,096 JPY (about 17.5 US\$). The average reward of the

role of the entrepreneur was 2,177 JPY (about 18.1 US\$) and that of the role of the underwriter was 2,008 JPY (about 16.7 US\$). The experiment sessions lasted for approximately 80 minutes, including instructions.

4.2 Testing hypothesis 1: The behavior of the entrepreneur

In this subsection, we test the hypothesis 1. Table 1 provides descriptive statistics for the results of the behavior of the entrepreneur.

Insert table 1 about here.

Earnings management ratio ($\frac{\mu}{\theta}$) is the amount of the earnings management (μ) by an entrepreneur divided by true earnings (θ). When the true earnings is 100 and the amount of the earning management is 50, for example, the ratio is 0.5. The higher it is, the more egregious lie she is telling. Share holding ratio (w) is the number of shares which an entrepreneur continues to hold at IPO divided by the number of shares she held before the IPO. When the total share of entrepreneurs are 100 and the share which entrepreneurs continue to hold are 50, for example, the ratio is 0.5. The higher it is, the higher the commitment level of entrepreneur is. Unreliability ratio ($\frac{E_e(\hat{\mu})}{\theta}$) is the expected amount by the entrepreneur for the underwriter's estimation of the earnings management ($E_e(\hat{\mu})$) divided by the true earnings (θ). This is the expectations for underwriters' decision making by the entrepreneur.

Table 1 shows the tendency that the average earnings management ratio and

the average share holding ratio were high (over 50%). The result implies that the entrepreneur told a lie with the high commitment level of share holding. Table 1 also reports, on the other hand, that the average unreliability ratio were lower than the average earnings management ratio. This result implies that the entrepreneur thought that the underwriter would take a optimistic estimation of earnings management and permit her lie as long as the entrepreneur took a high commitment level of share holding.

Figure 6 reports the scatter plot of the relation between the earnings management ratio and the share holding ratio.

Insert figure 6 about here.

Figure 6 shows that the participant who takes high rate of earnings management tends to have a higher commitment level of share holding. The rate of “The earnings management ratio is 100% and the share holding ratio is also 100%” is 30.8%. The rate of “The earnings management ratio is 100% and the share holding ratio is 50%” is 28.2%. The total of them is 59.0%. The result also implies that the entrepreneur told a lie with the high commitment level of share holding.

Table 2 focuses on the right column (the column in which earnings management ratio is 100%) of the figure 7, which is the number of observation of the participant who takes 100% of earnings management at each share holding ratio.

Insert table 2 about here.

Table 2 shows that the participant who takes 100% of earnings management tends to have a higher commitment level of share holding. There is a statistically significant difference among them (the Chi-squared test. $\chi^2(2) = 7.28$, p value = $0.0026 < 0.01$, effect size $w = 0.539$, $power = 0.67$). The result supports the hypothesis 1.

Figure 7 and table 3 provide the average share holding ratio at the each earnings management ratio.

Insert figure 7 and table 3 about here.

Figure 7 and table 3 show the tendency that the entrepreneur who takes a higher level of earnings management tends to hold the higher ratio of share, although there is not a statistically significant difference among the three groups (the Kruskal-Wallis test. $\chi^2(2, N = 39) = 2.531$, p value = 0.282 , effect size = 0.06).

Figure 8 and table 4 provide the average earnings management ratio at each commitment level of share holding.

Insert figure 8 and table 4 about here.

Figure 8 and table 4 show the tendency that the entrepreneur who takes a

higher commitment level of share holding tends to take the higher rate of earnings management, although there is not a statistically significant difference among the three groups (the Kruskal-Wallis test. $\chi^2(2, N = 39) = 2.520$, p value = 0.284, effect size = 0.06).

In conclusion, the results of our experiment support the hypothesis 1. As expected by our model, the entrepreneur told a lie with the high commitment level of share holding since she anticipated that the underwriter would permit her lie.

4.3 Testing hypothesis 2: The behavior of the underwriter

In this subsection, we test the hypothesis 2. Table 5, 6, 7 and 8 provide descriptive statistics for the results of the behavior of the underwriter.

Insert table 5 - 8 about here.

Earnings management estimation ratio ($\frac{\hat{\mu}}{e}$) is defined as the level of estimation of earnings, which is defined as the amount of estimation of earnings management ($\hat{\mu}$) divided by reported earnings (e). When reported earnings is 200 and the amount of estimation of earnings management is 50, for example, the ratio is 25%. The expected true earnings ($E_u(\theta)$) is defined as the amount of the true earnings (θ) that underwriter estimates. This is the expectations for entrepreneurs' decision making by the underwriters.

Table 5 reports the tendency that the amount of earnings management estioma-

tion ratio was totally low level, and the table 6 shows the tendency that the amount of ratio was especially low level when the share holding ratio was high (100%).

Table 7 shows the tendency that the underwriters estimated the true earnings adequately, and table 8 implies that their estimation of the true earnings was adequate regardless of the commitment level of share holding by entrepreneurs.

Table 9 provides the number of the participants who take the zero estimation of earnings management at the each reported earnings and the share holding ratio. Figure 9 shows the number especially when the reported earnings is 240.¹⁷

Insert table 9 and figure 9 about here.

There are two key points in table 9. First, when the reported earnings is 240 (the true earnings is equal to 120 and earnings management ratio is 100%), there is a bias of the number of the zero estimation among the share holding ratio: the higher the share holding ratio becomes, the higher the number of zero estimation is. Figure 10 shows this result. There is a statistically significant difference among them (the Chi-squared test. $\chi^2(2) = 7.82$, p value = 0.026 < 0.05, effect size $w = 0.843$, $power = 0.707$). Second, when the reported earnings is lower than 240, there is not the bias of the number of the zero estimation among the share holding ratio: the number of zero estimation is the same (about eight or nine, and the ratio per observation is about 0.67 or 0.75). The result supports Hypothesis 2. In our

¹⁷We extract the subsample in which the reported income is 240.

model, the underwriter tend to take a optimistic assessment, but when the true earnings is higher level (e.g. 120), he choose an estimation level depending on the ratio of share holding: the higher share holding ratio is, the more optimistic the assessment is.

Table 10 and figure 10 provides the average level of the permission of lie.

Insert table 10 and figure 10 about here.

The level of the permission of lie ($\frac{e - \widehat{\mu}}{E_u(\theta)}$) is defined as the corrected actual earnings ($e - \widehat{\mu}$) divided by expected true earnings ($E_u(\theta)$), which is the level that the underwriter would permit the entrepreneurs' lie. The higher the level is, the more permissive the underwriter is for the lie. When the expected true earnings is 100 and the corrected actual earnings is 150, for example, the level is 1.5. When it is higher than 1, the underwriter permits the entrepreneurs' lie. When the expected true earnings is 100 and the corrected actual earnings is 100, for example, the level is 1. When it is equal to 1, the underwriter does not permit the entrepreneurs' lie. When the expected true earnings is 100 and the corrected actual earnings is 50, for example, the level is 0.5. When it is lower than 1, the underwriter does not permit the entrepreneurs' lie and punishes her for the lie.

Table 10 indicates two key points: First, the level is higher than 1 at the all sample (1.23 on average). This implies that the underwriter is overall permissive for the lie. Second, the higher the share holding ratio becomes, the higher the

level is when reported earnings is relatively high. Figure 10 shows the tendency that the higher share holding ratio becomes, the higher the level is. There is a statistically significant difference among the three groups at the 10% level (the Kruskal-Wallis test. $\chi^2(2, N = 288) = 4.744$, p value = $0.093 < 0.10$). A post-hoc test using Mann-Whitney tests with Holm correction showed the significant differences between the group of 50% level of share holding and that of 100% level of share holding ($p = 0.082 < 0.10$, $r = 0.13$) and between the group of 0% level of share holding and that of 100% level of share holding ($p = 0.044 < 0.05$, $r = 0.15$).

This implies that the underwriter is permissive for the lie especially when the share holding ratio is 100%. The result supports Hypothesis 2. In our model, the underwriter tend to take a optimistic estimation of earnings management especially when share holding ratio is so high.

In conclusion, the results of our experiment support the hypothesis 2. As expected by our model, the underwriter tend to take a optimistic assessment especially when the share holding ratio is high, even though he knows the entrepreneur's lie.

The reason why the underwriter permit the entrepreneur's lie is supposed that he thinks that his optimistic assessment would raise the stock value and he would have a chance to get high profit. In short, the underwriter is not irrational but quite rational. Therefore, the underwriter rationally permits the entrepreneur's "Pareto white lie".

5 Extension: Solutions with Earnings Management

Costs

We show the solutions with earnings management costs by comparing with the solutions without them.

Case (I) A very popular firm with $a \geq x + 2\theta + 2N$

The underwriter chooses $\widehat{\mu}^* = 0$ in the same way as in the case without earnings management costs shown in Figure 2(a). However, there are earnings management costs $k\mu$ in the entrepreneur's payoff in this case.

$$\begin{aligned}
 U_e &= \{1 - (1 - p)w\}P_0 + wp(\alpha - qk\mu) \\
 &= [1 - \{1 - (1 - qk)p\}w]\mu + \{1 - (1 - p)w\}\{x + g(w) + \theta\} + wp\alpha. \\
 \frac{\partial U_e}{\partial \mu} &= 1 - \{1 - (1 - qk)p\}w.
 \end{aligned}$$

The solutions of the entrepreneur are

$$(\mu^*, w^*) = \begin{cases} (\theta, 1) & (\theta, 0 < w^* < 1) & (\theta, 0) & \text{when } \partial U_e / \partial \mu > 0 \\ (\text{any}, 1) & (\text{any}, 0 < w^* < 1) & & \text{when } \partial U_e / \partial \mu = 0 \\ (0, 1) & (0, 0 < w^* < 1) & & \text{when } \partial U_e / \partial \mu < 0 \end{cases} .$$

The proof is provided in Appendix C.

The implications of the solutions are twofold. First the entrepreneur does not

always manage earnings to the maximum degree because of the earnings management costs. Second when she sells all the shares that she owns, she manages the earnings to the maximum degree.

Case (II) An unpopular firm with $a < x + g(1) - f(1) + \theta + N$

The underwriter chooses $\widehat{\mu}^* = \widehat{\mu}_1$ in the same way as in the case without earnings management shown in Figure 2(b). The entrepreneur's payoff is

$$U_e = \{1 - (1 - p)w\}\{f(w) + (w - 2)N + a\} + wp(\alpha - qk\mu).$$

Since $\partial U_e / \partial \mu = -wpqk < 0$, the entrepreneur chooses $\mu^* = 0$. Hence, U_e can be written as

$$U_e = \{1 - (1 - p)w\}\{f(w) + (w - 2)N + a\} + wpa.$$

Since this is the same as equation (1) in the case without the earnings management costs, the optimal retention can be obtained in the same way. The implications of the solutions are also the same as in the case without earnings management costs¹⁸.

Case (III) For a firm with $x + g(1) - f(1) + \theta + N \leq a < x + 2\theta + 2N$

¹⁸The only difference from the case without earnings management costs is that the entrepreneur chooses $\mu^* = 0$. However it does not change the implications that she does not have an incentive to manage earnings because the underwriter does not use them when deciding the offering price.

The entrepreneur's payoff is

$$U_e = \{1 - (1 - p)w\}P_0 + wp(\alpha - qk\mu).$$

We examine whether the entrepreneur can increase her payoff through changing the equilibriums by raising the ownership retention. Note that in the very popular equilibrium,

$$(\mu^*, w^*) = \begin{cases} (\theta, 1) & (\theta, 0 < w^* < 1) & (\theta, 0) & \text{when } \partial U_e / \partial \mu > 0 \\ (\text{any}, 1) & (\text{any}, 0 < w^* < 1) & & \text{when } \partial U_e / \partial \mu = 0 \\ (0, 1) & (0, 0 < w^* < 1) & & \text{when } \partial U_e / \partial \mu < 0 \end{cases} .$$

Insert Figure 11 (a),(b),(c) about here.

The conditions that the entrepreneur can increase her payoff by raising the ownership retention are that in the very popular equilibrium she does not sell all the shares she owns, in the unpopular equilibrium she does not hold all the shares she owns, and her payoff increases from the change in the equilibriums.

When the expected cost qk is so small that $\mu^* = \theta$ in the very popular equilibrium and that $\phi_0^L(1) = 0$ locates above $\phi^{H,\max}(0) = 0$, the shadowed area in Figure 11(a) and (b) satisfies all the conditions above, and for any points (p, α) in the shadowed area, there exist w_1 and Δw ($\Delta w > 0$) that satisfy $0 \leq w_1 < w_2 = w_1 + \Delta w \leq 1$. The proof is provided in Appendix F.

When the expected cost qk is so large that $\mu^* = \text{any}(0 \leq \mu^* \leq \theta)$ or 0 in the very popular equilibrium, the shadowed area in Figure 11(c) satisfies all the conditions above, and for any points (p, α) in the area, there exist w_1 and Δw ($\Delta w > 0$) that satisfy $0 \leq w_1 < w_2 = w_1 + \Delta w \leq 1$. The proof is provided in Appendix G.

Taken together, there exist some cases that the payoff of the entrepreneur can be increased through changing the underwriter's behavior by increasing the owner's retention. This conclusion is same as that of Section 2. Hence, the implications in the case without earnings management costs can be extended generally to the case with them.

6 Conclusion

This paper answers the problem “When and how do people choose to lie?” through introducing strategic commitment by potential liars. In order to examine the role of commitment, we focus on a specific economic setting where an entrepreneur plans to file for an initial public offering (IPO). More specifically, we consider the situation where an entrepreneur (IPO firm) issues new shares and reports earnings, and then an underwriter assesses the earnings and sets the offering price.

We develop a theoretical model on the assumption that there is a divergence of investors' opinions, and hence the demand curve of the share is downsloping to right. We have predictions that the entrepreneur of a popular firm raises the ownership retention and manages earnings upward to a maximum degree and that the underwriter chooses to estimate no earnings management because he knows

higher ownership retention is perceived as good news by investors.

We test the predictions by laboratory experiment. In other words, the ownership retention works as a signal of commitment so that the interests of the entrepreneur and the underwriter are aligned. In this situation, *both* the entrepreneur and the underwriter can benefit from overstating the earnings and setting the higher offering price.

To the best of our knowledge, this paper is in experimental studies the first that investigates both the ownership retention and the earnings management in the setting of IPO. Therefore, this paper can provide the possible explanation to the relationship between ownership retention and earnings management in IPO. Our research can be a milestone in this field. Our research can be extended to various research examining when and how to lie in economic environments.

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Appendix A

The axis of symmetry of $U_s = -[\widehat{\mu} - (x + g(w) + e)][\widehat{\mu} - (x + g(w) - f(w) + e - a)]$ is

$$\widehat{\mu}_a = x + g(w) + e - \frac{1}{2} [f(w) + a].$$

Since $\widehat{\mu}_1 = x + g(w) - f(w) + e - a + (2 - w)N$,

$$\widehat{\mu}_a - \widehat{\mu}_1 = \frac{1}{2} [f(w) + a - 2(2 - w)N].$$

Consider a case of $\widehat{\mu}_a \leq \widehat{\mu}_1$ and $w = 1$, that is

$$a \leq 2N - f(1).$$

Since $a > 2N$ from the assumption of the demand function, there do not exist any cases of $\widehat{\mu}_a \leq \widehat{\mu}_1$ and $w = 1$. However in the real world, there exist IPO firms in which entrepreneurs hold all the shares they own ($w = 1$). Hence, it is appropriate to assume $\widehat{\mu}_a > \widehat{\mu}_1$.

Appendix B

From $\phi_0^H(0) \equiv p\alpha - (1 - p)(x + 2\theta) + g'(0) > 0$,

$$\alpha > \frac{1}{p}(x + 2\theta - g'(0)) - (x + 2\theta)$$

where $x + 2\theta - g'(0) > 0$.

From $\phi_0^L(1) \equiv p\alpha + f'(1) + N - (1-p)\{f(1) + f'(1) + a\} < 0$,

$$\alpha < \frac{1}{p}\{f(1) + a - N\} - \{f(1) + f'(1) + a\}$$

where $f(1) + a - N > 0$, $f(1) + f'(1) + a > 0$.

$\phi_0^H(0) = 0$ represents a set of marginal points (p, α) that make the entrepreneur of the very popular firm sell all the shares she owns. $\phi_0^L(1) = 0$ represents a set of marginal points (p, α) that make the entrepreneur of the unpopular firm hold all the shares she owns. Since for a certain $p(0 < p < 1)$, α that satisfies $\phi_0^L(1) = 0$ is larger than α that satisfies $\phi_0^H(0) = 0$, the curve $\phi_0^L(1) = 0$ locates above the curve $\phi_0^H(0) = 0$. Hence, the set of (p, α) that satisfies $\phi_0^H(0) > 0$ and $\phi_0^L(1) < 0$ is the shadowed area in Figure 5.

We prove there exists $(w_1, w_2 = w_1 + \Delta w)$ that satisfies $U_e^2 > U_e^1$ in that area. Let P_0^H and P_0^L be offering prices in the very popular equilibrium and in the unpopular equilibrium respectively. That is

$$P_0^H \equiv x + g(w_2) + 2\theta, \quad P_0^L = f(w_1) + (w_1 - 2)N + a \quad (P_0^H > P_0^L).$$

Consider Δw such that

$$0 < \Delta w < (1 - w_1) \left(1 - \frac{P_0^L}{P_0^H}\right). \quad (\text{B1})$$

Since

$$(1 - w_1) \left(1 - \frac{P_0^L}{P_0^H}\right) < 1,$$

$$0 < \Delta w < (1 - w_1) \left(1 - \frac{P_0^L}{P_0^H}\right) < 1.$$

Hence,

$$w_1 < w_2 = w_1 + \Delta w < w_1 + (1 - w_1) \left(1 - \frac{P_0^L}{P_0^H}\right).$$

Since

$$1 - \left[w_1 + (1 - w_1) \left(1 - \frac{P_0^L}{P_0^H}\right) \right] = (1 - w_1) \frac{P_0^L}{P_0^H} \geq 0,$$

$$0 \leq w_1 < w_2 = w_1 + \Delta w < w_1 + (1 - w_1) \left(1 - \frac{P_0^L}{P_0^H}\right) \leq 1. \quad (\text{B2})$$

From $U_e^2 > U_e^1$ and $(1 - w_1)P_0^L - (1 - w_2)P_0^H < 0$ ¹⁹,

$$\alpha > \frac{w_1 P_0^L - w_2 P_0^H}{w_2 - w_1} + \frac{1}{p} \cdot \frac{(1 - w_1)P_0^L - (1 - w_2)P_0^H}{w_2 - w_1} \quad (\text{B3})$$

where $\frac{w_1 P_0^L - w_2 P_0^H}{w_2 - w_1} < 0$ and $\frac{(1 - w_1)P_0^L - (1 - w_2)P_0^H}{w_2 - w_1} < 0$.

From equation (B2) and (B3), there exists $(w_1, w_2 = w_1 + \Delta w)$ that satisfies $U_e^2 > U_e^1$ in the shadowed area in Figure 5.

Appendix C

We find we solutions in the way as follows: First we find the optimal retention in case $\mu^* = \theta$, any $(0 \leq \mu^* \leq \theta)$, and 0. Next for each case we examine whether $\partial U_e / \partial \mu > 0$, $\partial U_e / \partial \mu = 0$, and $\partial U_e / \partial \mu < 0$ holds.

(i) when $\mu^* = \theta$, that is $\partial U_e / \partial \mu > 0$,

$$U_e = \{1 - (1 - p)w\}\{x + g(w) + 2\theta\} + wp(\alpha - qk\theta).$$

$$\begin{aligned} \frac{\partial U_e}{\partial w} &= -(1 - p)\{x + g(w) + 2\theta\} + \{1 - (1 - p)w\}g'(w) + p(\alpha - qk\theta) \\ &= p(\alpha - qk\theta) - (1 - p)\{x + g(w) + wg'(w) + 2\theta\} + g'(w) \equiv \phi^{H, \max}(w). \end{aligned}$$

¹⁹ $(1 - w_1)P_0^L - (1 - w_2)P_0^H < 0$ can be easily obtained from equation (B1).

Since $g'(w) > 0, g''(w) \leq 0$,

$$\frac{d^2 U_e}{dw^2} = \frac{d\phi^{H,\max}(w)}{dw} = -2(1-p)g'(w) + \{1 - (1-p)w\}g''(w) < 0.$$

Hence, $\phi^{H,\max}(w)$ is a strictly decreasing function of w .

$$\begin{aligned} \frac{\partial \phi^{H,\max}(w)}{\partial p} &= \alpha + x + g(w) + wg'(w) + (2 - qk)\theta > 0 \quad (0 < q < 1, 0 < k \leq 2) \\ \frac{\partial \phi^{H,\max}(w)}{\partial \alpha} &= p > 0 \\ \frac{\partial \phi^{H,\max}(w)}{\partial q} &= -pk\theta < 0 \\ \frac{\partial \phi^{H,\max}(w)}{\partial k} &= -pq\theta < 0 \end{aligned}$$

Hence, the larger p and the larger α shift the curve $\phi^{H,\max}(w)$ upward, and the larger q and the larger k shift the curve $\phi^{H,\max}(w)$ downward. Note that $\phi^{H,\max}(w)$ is a strictly decreasing function of w .

[A^{max}]

When p and/or α are large enough and/or q and/or k are small enough to hold $\phi^{H,\max}(1) \geq 0, w^* = 1$. Hence, there exist $(p, \alpha, q, k)(0 < p < 1, 0 < q < 1, 0 < k \leq 2)$ that hold $\partial U_e / \partial \mu|_{w^*=1} = (1 - qk)p > 0$.

[B^{max}]

When $p, \alpha, q,$ and k are such that hold $\phi^{H,\max}(1) < 0 < \phi^{H,\max}(0), 0 < w^* < 1$.

Hence, there exist (p, α, q, k) ($0 < p < 1, 0 < q < 1, 0 < k \leq 2$) that hold $\partial U_e / \partial \mu|_{0 < w^* < 1} = 1 - \{1 - (1 - qk)p\}w^* > 0$. The proof is provided by Appendix D.

[C^{max}]

When p and/or α are small enough and/or q and/or k are large enough to hold $\phi^{H,\max}(0) \leq 0, w^* = 0$. Since $\partial U_e / \partial \mu|_{w^*=0} = 1$, any (p, α, q, k) ($0 < p < 1, 0 < q < 1, 0 < k \leq 2$) hold $\partial U_e / \partial \mu|_{w^*=0} > 0$.

(ii) when $\mu^* = \text{any}(0 \leq \mu^* \leq \theta)$, that is $\partial U_e / \partial \mu = 0$, or $\mu^* = 0$, that is $\partial U_e / \partial \mu < 0$,

$$U_e = \{1 - (1 - p)w\}\{x + g(w) + \theta\} + wp\alpha.$$

$$\begin{aligned} \frac{\partial U_e}{\partial w} &= -(1 - p)\{x + g(w) + \theta\} + \{1 - (1 - p)w\}g'(w) + p\alpha \\ &= p\alpha - (1 - p)\{x + g(w) + wg'(w) + \theta\} + g'(w) \equiv \phi^{H,\text{any},0}(w). \end{aligned}$$

Since $g'(w) > 0, g''(w) \leq 0$,

$$\frac{d^2 U_e}{dw^2} = \frac{d\phi^{H,\text{any},0}(w)}{dw} = -2(1 - p)g'(w) + \{1 - (1 - p)w\}g''(w) < 0.$$

Hence, $\phi^{H,any,0}(w)$ is a strictly decreasing function of w .

$$\frac{\partial \phi^{H,any,0}(w)}{\partial p} = \alpha + x + g(w) + wg'(w) + \theta > 0$$

$$\frac{\partial \phi^{H,any,0}(w)}{\partial \alpha} = p > 0$$

Note that $\phi^{H,any,0}(w)$ is a strictly decreasing function of w .

[A^{any,0}]

When p and/or α are large enough to hold $\phi^{H,any,0}(1) \geq 0$, $w^* = 1$. Hence, there exists $(p, \alpha, q, k)(0 < p < 1, 0 < q < 1, 0 < k \leq 2)$ that holds $\partial U_e / \partial \mu|_{w^*=1} = (1 - qk)p = 0$. There also exists $(p, \alpha, q, k)(0 < p < 1, 0 < q < 1, 0 < k \leq 2)$ that holds $\partial U_e / \partial \mu|_{w^*=1} = (1 - qk)p < 0$.

[B^{any,0}]

When p and α are such that hold $\phi^{H,any,0}(1) < 0 < \phi^{H,any,0}(0)$, $0 < w^* < 1$. Hence, there exist $(p, \alpha, q, k)(0 < p < 1, 0 < q < 1, 0 < k \leq 2)$ that hold $\partial U_e / \partial \mu|_{0 < w^* < 1} = 1 - \{1 - (1 - qk)p\}w^* = 0$. There also exist $(p, \alpha, q, k)(0 < p < 1, 0 < q < 1, 0 < k \leq 2)$ that hold $\partial U_e / \partial \mu|_{0 < w^* < 1} = 1 - \{1 - (1 - qk)p\}w^* < 0$. The proof is provided by Appendix E.

[C^{any,0}]

When p and/or α are small enough to hold $\phi^{H,any,0}(0) \leq 0$, $w^* = 0$. Since $\partial U_e / \partial \mu|_{w^*=0} = 1$, there does not exist any $(p, \alpha, q, k)(0 < p < 1, 0 < q < 1, 0 < k \leq 2)$ that hold $\partial U_e / \partial \mu|_{w^*=0} \leq 0$.

From (i) and (ii), the solutions are

$$(\mu^*, w^*) = \begin{cases} (\theta, 1) & (\theta, 0 < w^* < 1) & (\theta, 0) & \text{when } \partial U_e / \partial \mu > 0 \\ (\text{any}, 1) & (\text{any}, 0 < w^* < 1) & & \text{when } \partial U_e / \partial \mu = 0 \\ (0, 1) & (0, 0 < w^* < 1) & & \text{when } \partial U_e / \partial \mu < 0 \end{cases} .$$

Appendix D

For a certain p, q, k where $0 < p < 1$ and $0 < qk < 1$, we can select α large enough to satisfy $0 \simeq \phi^{H, \max}(1) < 0$. Then

$$0 < w^* < 1 \quad (w^* \simeq 1).$$

$$\frac{\partial U_e}{\partial \mu} \simeq (1 - qk)p > 0.$$

Appendix E

[A^{any,0}]

For a certain p, α that satisfies $\phi^{H, \text{any}, 0}(1) \geq 0$, $w^* = 1$.

For a certain q, k that satisfies $qk = 1$, $\partial U_e / \partial \mu|_{w^*=1} = (1 - qk)p = 0$.

For a certain q, k that satisfies $qk < 1$, $\partial U_e / \partial \mu|_{w^*=1} = (1 - qk)p < 0$.

[B^{any,0}]

For a certain p , we can select α large enough to satisfy $0 \simeq \phi^{H,any,0}(1) < 0$.

$$0 < w^* < 1 \quad (w^* \simeq 1).$$

$$\frac{\partial U_e}{\partial \mu} \simeq (1 - qk)p$$

In the vicinity of $qk = 1$, there exists (q, k) that satisfies $\partial U_e / \partial \mu|_{0 < w^* < 1} = 0$.

Since $0 < qk < 2$, (q, k) that satisfies $qk \simeq 2$ and $qk < 2$, $\partial U_e / \partial \mu|_{0 < w^* < 1} < 0$.

Appendix F

The offering price in the unpopular equilibrium is

$$x + g(w_1) + \theta - \widehat{\mu}_1 \equiv P_0^{L,0}.$$

The offering price in the very popular equilibrium is

$$x + g(w_2) + 2\theta \equiv P_0^H.$$

Hence,

$$P_0^H > P_0^{L,0}.$$

From $U_e^2 > U_e^1$ and $(1 - w_1)P_0^{L,0} - (1 - w_2)P_0^H < 0$ ²⁰,

$$\alpha > \frac{w_1 P_0^{L,0} - w_2 P_0^H + w_2 q k \theta}{w_2 - w_1} + \frac{1}{p} \cdot \frac{(1 - w_1) P_0^{L,0} - (1 - w_2) P_0^H}{w_2 - w_1}$$

where $\frac{(1 - w_1) P_0^{L,0} - (1 - w_2) P_0^H}{w_2 - w_1} < 0$.

Appendix G

The offering price in the unpopular equilibrium is

$$x + g(w_1) + \theta - \widehat{\mu}_1 \equiv P_0^{L,0}.$$

The offering price in the very popular equilibrium is

$$x + g(w_2) + \theta \equiv P_0^{H,0}.$$

Hence,

$$P_0^{H,0} > P_0^{L,0}.$$

²⁰ $(1 - w_1)P_0^{L,0} - (1 - w_2)P_0^H < 0$ is obtained in the same way as in the case without the earnings management costs.

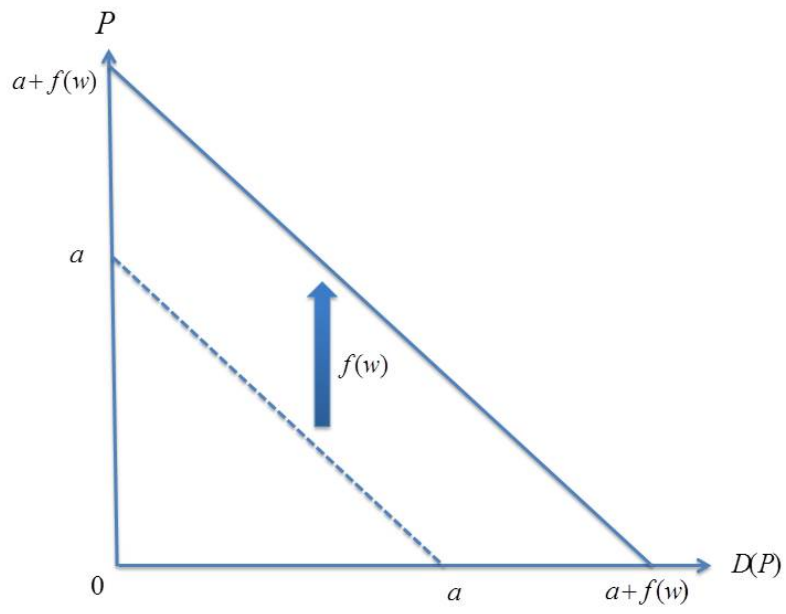
From $U_e^2 > U_e^1$ and $(1 - w_1)P_0^{L,0} - (1 - w_2)P_0^{H,0} < 0$ ²¹,

$$\alpha > \frac{w_1 P_0^{L,0} - w_2 P_0^{H,0}}{w_2 - w_1} + \frac{1}{p} \cdot \frac{(1 - w_1)P_0^{L,0} - (1 - w_2)P_0^{H,0}}{w_2 - w_1}$$

where $\frac{w_1 P_0^{L,0} - w_2 P_0^{H,0}}{w_2 - w_1} < 0$ and $\frac{(1 - w_1)P_0^{L,0} - (1 - w_2)P_0^{H,0}}{w_2 - w_1} < 0$.

²¹ $(1 - w_1)P_0^{L,0} - (1 - w_2)P_0^{H,0} < 0$ is obtained in the same way as in the case without the earnings management costs.

Figure 1 Demand Curve.



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Figure 2(a) Payoff of an underwriter of the very popular firm.
($a \geq x + 2\theta + 2N$)

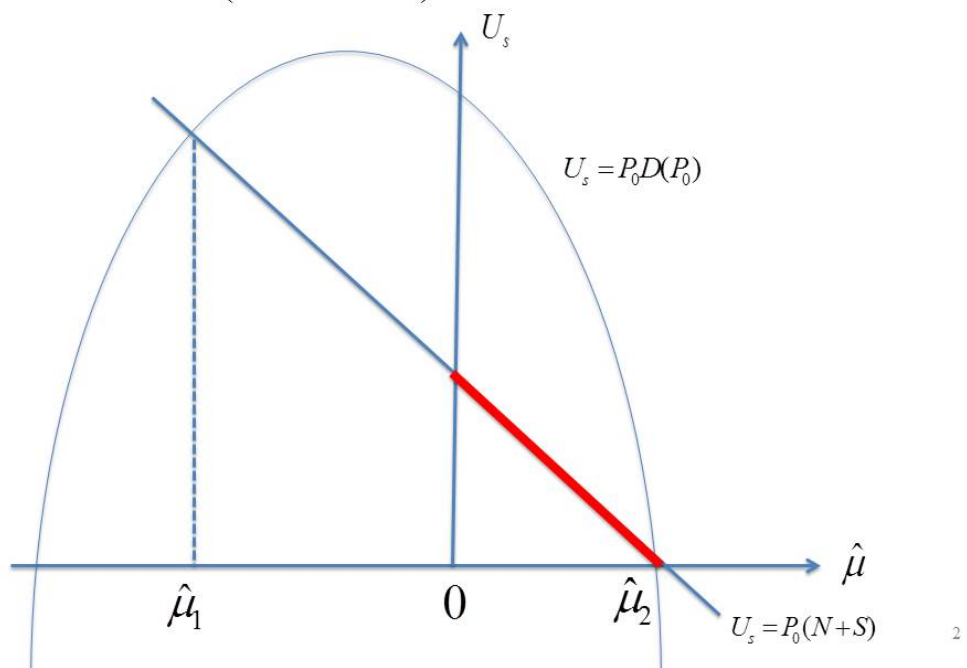


Figure 2(b) Payoff of an underwriter of the unpopular firm.
 $(a < x + g(1) - f(1) + \theta + N)$

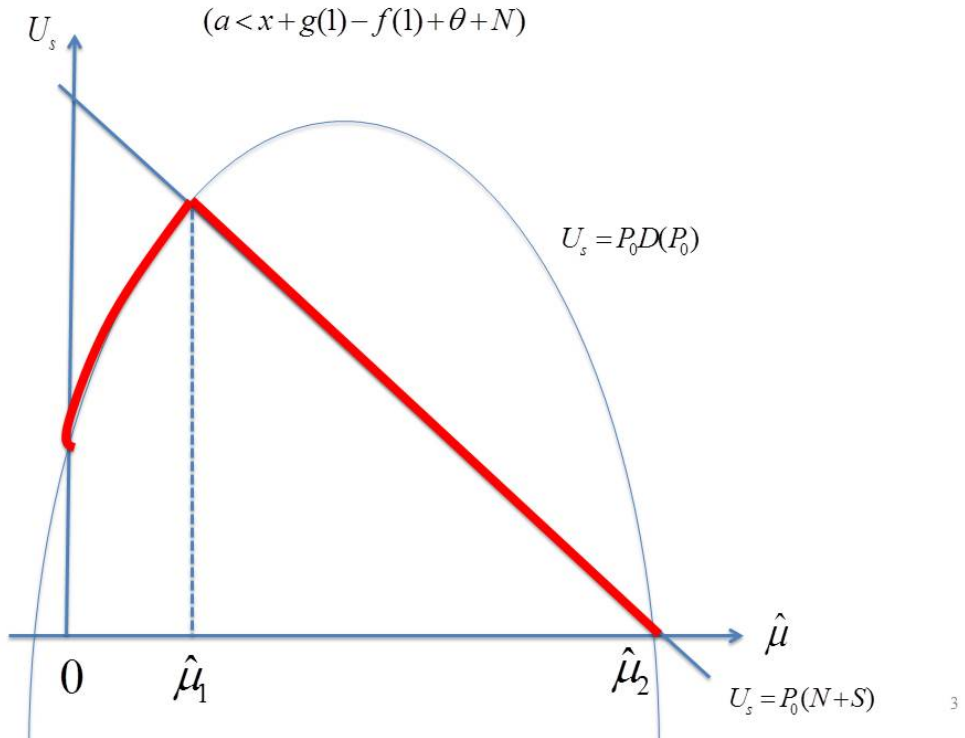


Figure 3 Determination of the optimal retention of the very popular firm.

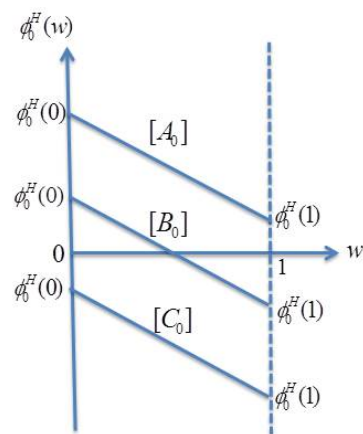


Figure 4 Determination of the optimal retention of the unpopular firm.

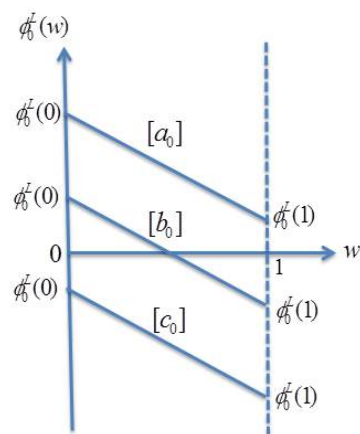


Figure 5 The area in which the entrepreneur can change the equilibriums without the earnings management costs.

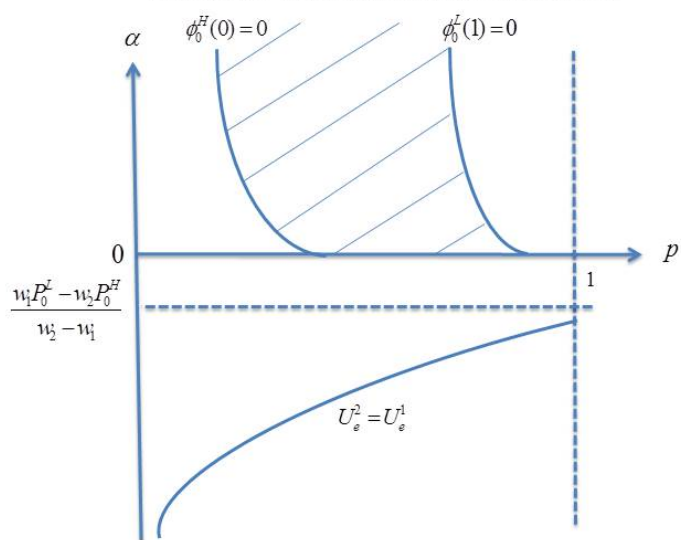


Figure 6: Scatter plot of the relation between earnings management ratio and share holding ratio

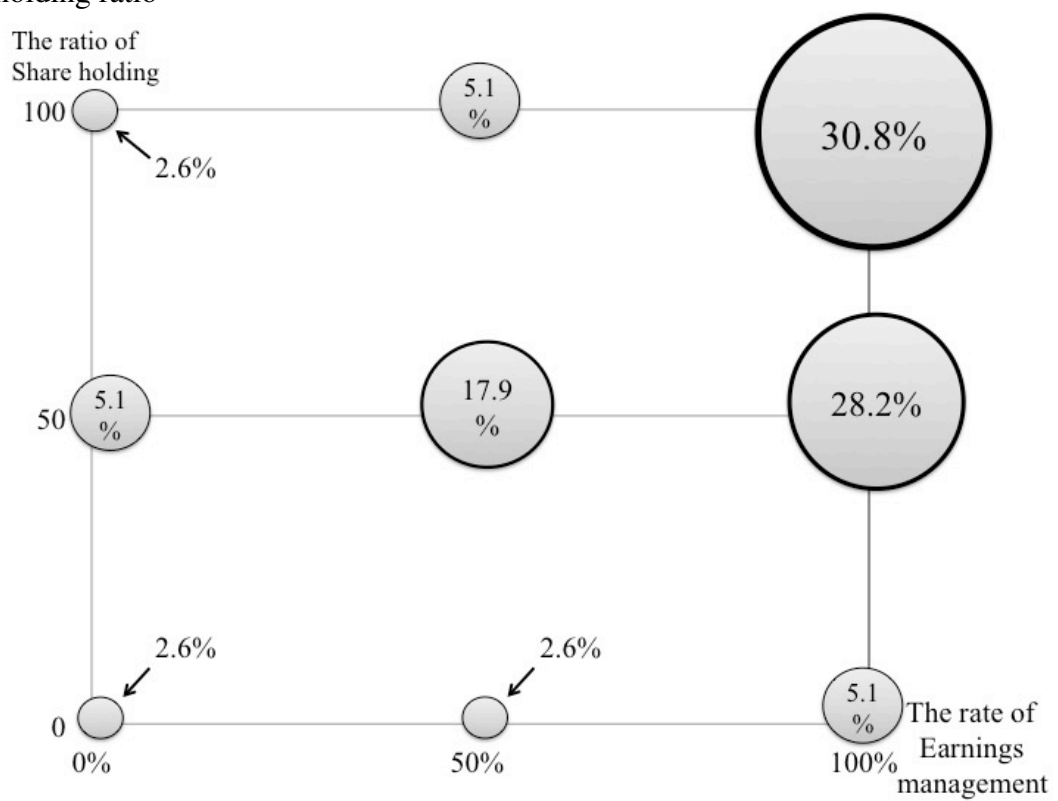


Figure 7: The average share holding ratio at the each earnings management ratio

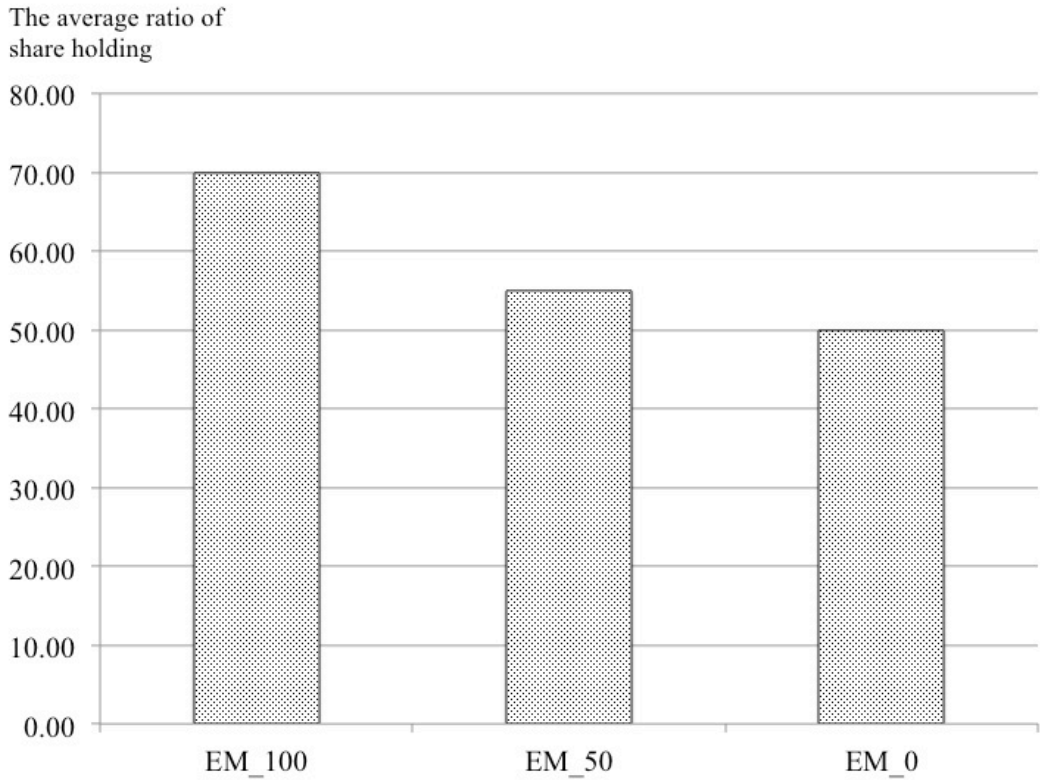


Figure 8: The average earnings management ratio at the each commitment level of share holding

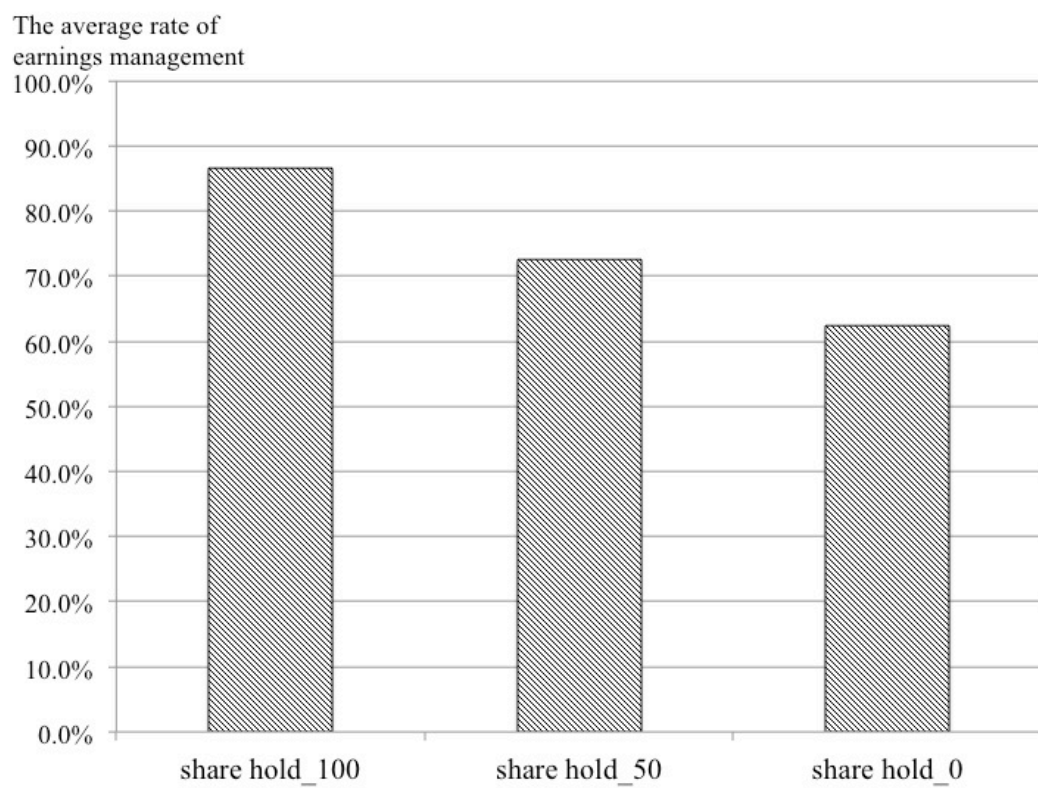


Figure 9: The number of the zero estimation of earnings management at the each commitment level of share holding (when the reported income is 240)

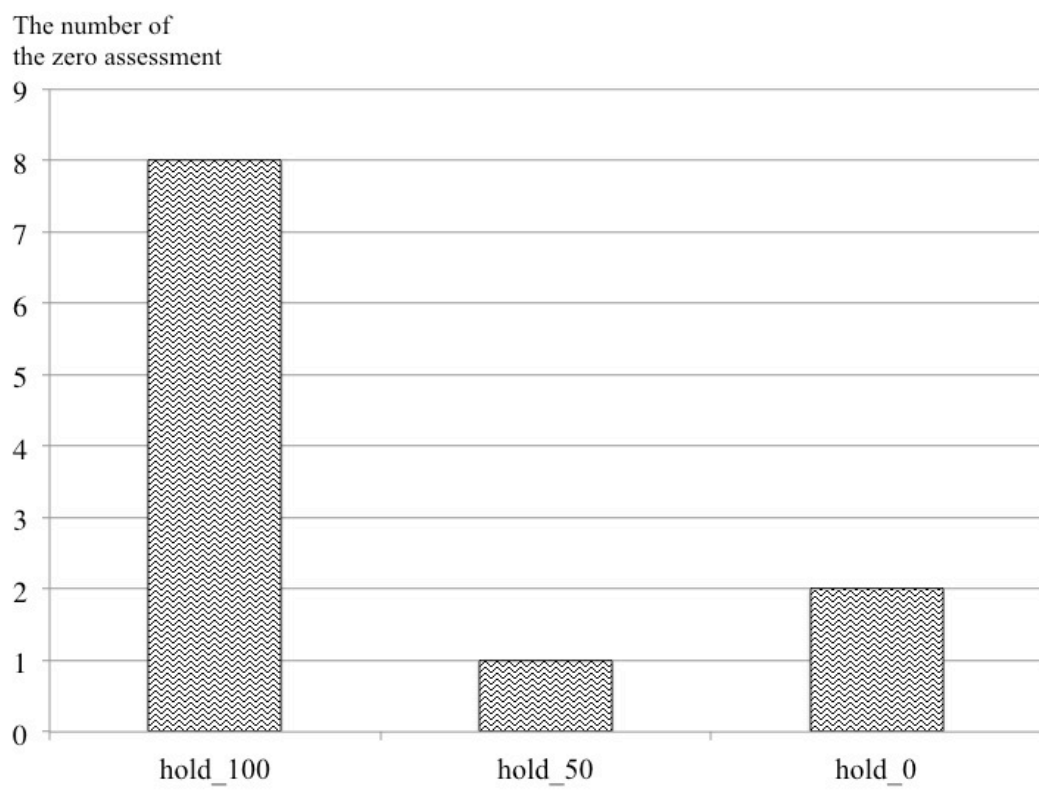


Figure 10: The average level of permission of lie at the each commitment level of share holding

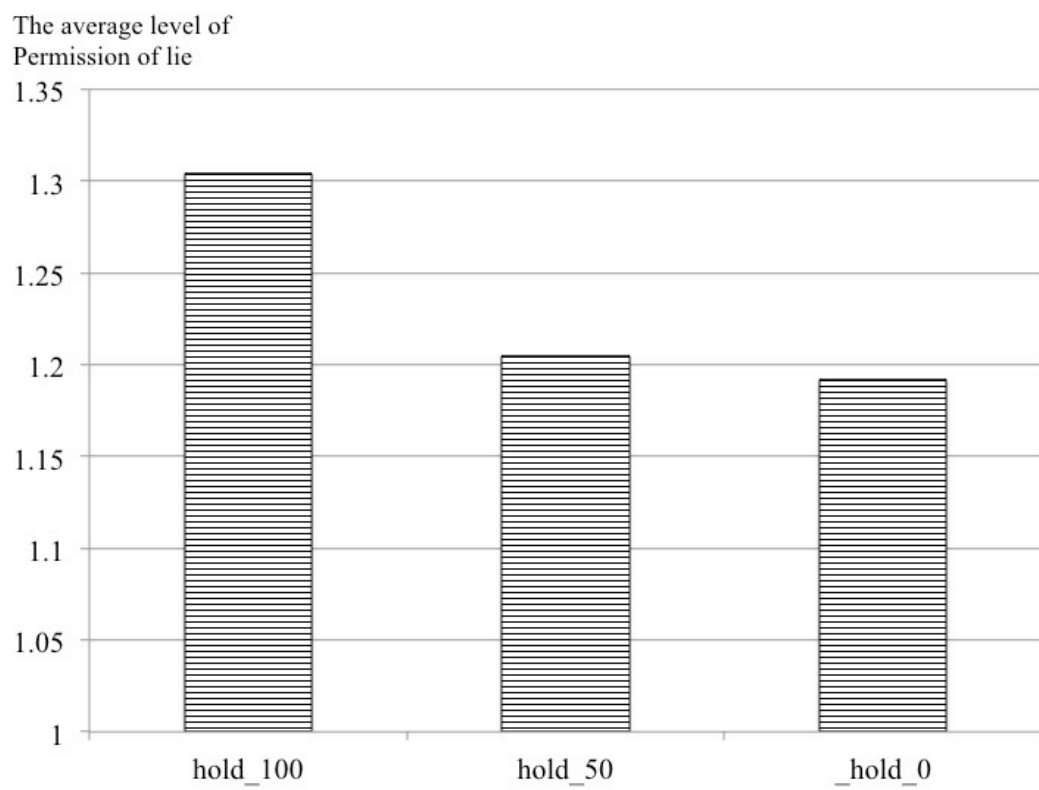
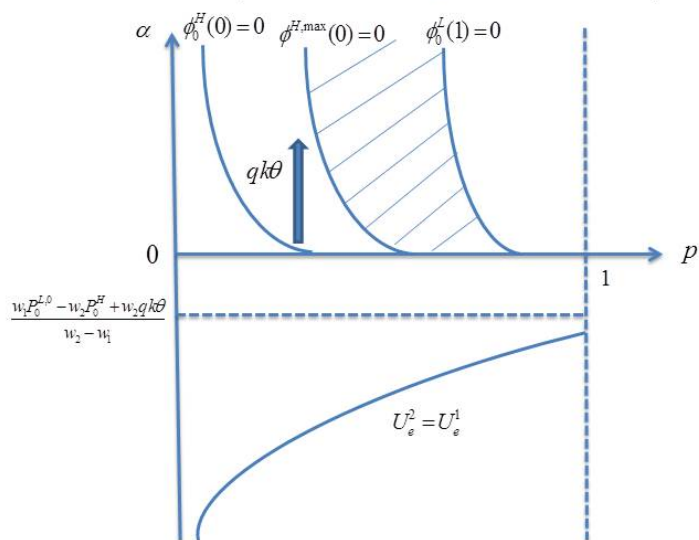


Figure 11(a) The area in which the entrepreneur can change the equilibriums with the earnings management costs when $\mu^* = \theta$ in the very popular equilibrium. (in the case of $w_1 P_0^{L,0} - w_2 P_0^H + w_2 q k \theta \leq 0$)



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Figure 11(b) The area in which the entrepreneur can change the equilibriums with the earnings management costs when $\mu^* = \theta$ in the very popular equilibrium. (in the case of $w_1 P_0^{L,0} - w_2 P_0^H + w_2 q k \theta > 0$)

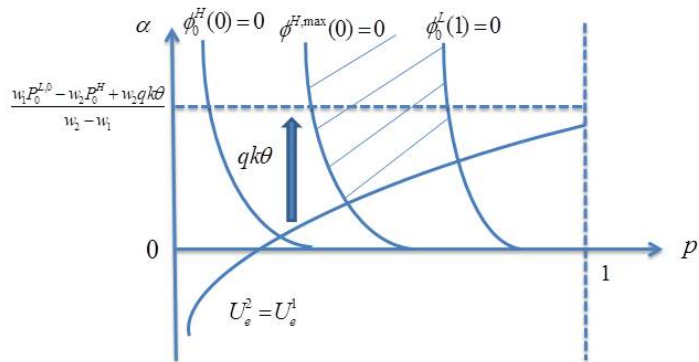


Figure 11(c) The area in which the entrepreneur can change the equilibriums with the earnings management costs when $\mu^* = \text{any or } 0$.

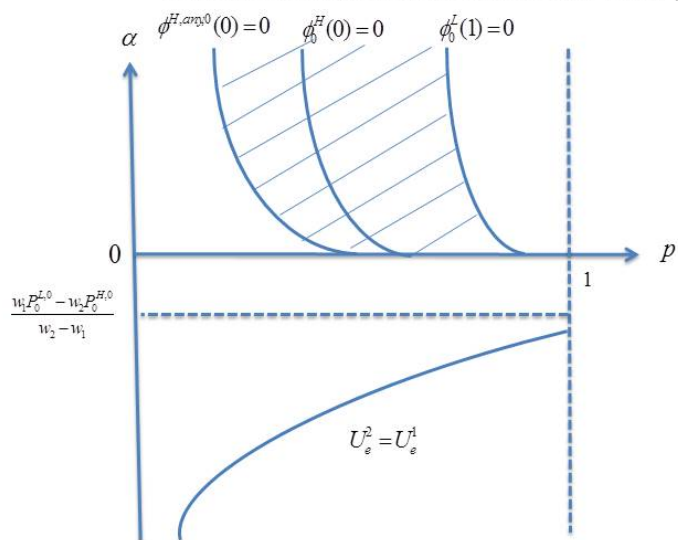


Table 1: The results of the behavior of the entrepreneur

		Total	True earnings		
			80	100	120
Observation		39	13	13	13
Earnings management ratio	Ave.	0.73	0.88	0.76	0.65
	S.D.	0.33	0.21	0.31	0.41
Share holding ratio	Ave.	0.64	0.73	0.57	0.61
	S.D.	0.31	0.31	0.26	0.34
Unreliability ratio	Ave.	0.44	0.41	0.51	0.41
	S.D.	0.47	0.49	0.51	0.38

Table 2: The number of observation of participants who takes 100% earnings management at each commitment level of share holding

		Share holding ratio			
		Total	100	50	0
Observation	25	12	11	2	
(ratio)		(0.48)	(0.44)	(0.08)	
<i>p</i> value		0.026			

Table 3: Share holding ratio at each level of earnings management

		earnings management ratio		
		100	50	0
Observation	25	10	4	
Average	0.70	0.55	0.50	
S.D.	0.31	0.26	0.35	

Table 4: The average earnings management ratio at the each commitment level of share holding

	Share holding ratio		
	100	50	0
Observation	15	20	4
Average	0.86	0.73	0.63
S.D.	0.29	0.33	0.41

Table 5: The results of the behavior of the underwriter(1): Earnings management estimation ratio at the each reported earnings

	Total	Reported earnings							
	240	200	180	160	150	120	100	80	
Observation	288	36	36	36	36	36	36	36	36
Average	0.18	0.29	0.23	0.20	0.17	0.15	0.16	0.13	0.11
S.D.	0.28	0.30	0.31	0.32	0.28	0.25	0.27	0.23	0.20

Table 6: The results of the behavior of the underwriter(2): Earnings management estimation ratio at the each share holding ratio

	Share holding ratio		
	100	50	0
Observation	96	96	96
Average	0.169	0.188	0.198
S.D.	0.31	0.26	0.26

Table 7: The results of the behavior of the underwriter(3): The expected true earnings at the each reported earnings

	Total	Reported earnings							
	240	200	180	160	150	120	100	80	
Observation	288	36	36	36	36	36	36	36	36
Average	100.7	113.9	101.1	113.9	85.0	100.6	108.9	98.3	83.9
S.D.	15.8	13.2	9.4	12.3	10.9	8.8	16.0	8.7	10.4

Table 8: The results of the behavior of the underwriter(4): The expected true earnings at the each share holding ratio

	Share holding ratio		
	100	50	0
Observation	96	96	96
Average	99.2	101.9	101.0
S.D.	16.8	14.2	16.2

Table 9: The number of the zero estimation of earnings management at the each reported earnings and the share holding ratio

Reported earnings		Share holding ratio		
		100	50	0
240	Obs.	12	12	12
	zero estimation	8	1	2
	the ratio	0.67	0.08	0.17
200	Obs.	12	12	12
	zero estimation	8	7	3
	the ratio	0.67	0.58	0.25
180	Obs.	12	12	12
	zero estimation	8	8	7
	the ratio	0.67	0.67	0.58
160	Obs.	12	12	12
	zero estimation	8	9	7
	the ratio	0.67	0.75	0.58
150	Obs.	12	12	12
	zero estimation	8	8	8
	the ratio	0.67	0.67	0.67
120	Obs.	12	12	12
	zero estimation	8	8	8
	the ratio	0.67	0.67	0.67
100	Obs.	12	12	12
	zero estimation	9	8	8
	the ratio	0.75	0.67	0.67
80	Obs.	12	12	12
	zero estimation	9	8	9
	the ratio	0.75	0.67	0.75

Table 10: The average level of permission of lie at the each reported earnings and the share holding ratio

		Reported earnings								
		Total	240	200	180	160	150	120	100	80
Total	Obs.	288	36	36	36	36	36	36	36	36
	Ave.	1.23	1.53	1.53	1.28	1.60	1.27	0.92	0.88	0.86
	S.D.	0.57	0.74	0.63	0.51	0.58	0.39	0.31	0.24	0.23
hold_100	Obs.	96	12	12	12	12	12	12	12	12
	Ave.	1.30	1.75	1.59	1.42	1.67	1.29	0.99	0.88	0.85
	S.D.	0.63	0.84	0.73	0.44	0.59	0.46	0.38	0.32	0.29
hold_50	Obs.	96	12	12	12	12	12	12	12	12
	Ave.	1.20	1.35	1.61	1.22	1.62	1.23	0.88	0.88	0.85
	S.D.	0.52	0.55	0.52	0.55	0.54	0.39	0.26	0.20	0.21
hold_0	Obs.	96	12	12	12	12	12	12	12	12
	Ave.	1.19	1.48	1.40	1.19	1.50	1.28	0.91	0.89	0.90
	S.D.	0.53	0.74	0.60	0.49	0.60	0.29	0.28	0.17	0.15