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Does Conservative Accounting Affect the Investment Behavior of a Company?

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Abstract: This paper analyzed how conservatism accounting affects a company's investment execution and management's efforts. Conservative accounting discloses accounting information by biasing downwards information. Therefore, conservative accounting intuitively reduces the investment, and management is not likely to make an effort. However, the analysis of this paper, on the contrary, strengthening the degree of conservative accounting by combining it with compensation for management, thereby enables management to find more investment opportunities, to make more investment, to make more effort. As a result, it showed that corporate value will increase. Management has tendency to be hesitant to tighten accounting estimates when acquiring a company, and there is a claim that such tightening hinders promotion of acquisition. On the contrary, the argument of this paper presents the opposite result. If management do not raise the degree of conservatism accounting, excessive investment will be done, so management will carry out excessive investment with the risk of impairment in the future. However, by combining raising the management fee and raising the degree of conservatism accounting, it is possible to draw management's efforts and maximize corporate value.

Key words: conservatism accounting; management compensation; investment behavior; incentive by shareholders

JEL codes: D80, C11, C62

1. Introduction

In April 2017, Japan Post changed its income prospects from the surplus of 320 billion yen to the forecast for the 40 billion yen loss account settlement. This was because a 400 billion yen impairment loss occurred in a logistics subsidiary acquired in Australia. Sony also announced 112.1 billion yen impairment on movie business. This incorporates the impairment of the goodwill of old Colombian movies equivalent to the current Sony Pictures.

The number of Japanese companies acquiring large overseas companies with huge funds is increasing. In addition, the acquiring company has adopted international accounting standards and amortizes goodwill. Impairment of goodwill indicates that the purchase price was too high in the aftermath and is attributable to excessive investment. According to Japanese accounting standards, goodwill is a combination of equal amortization and impairment test within a period of 20 years, and impairment of goodwill never occurs suddenly.

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If amortizing rules, annual depreciation will be a constraint on the purchase price, making it difficult to pay a large number of acquisition premiums. Selection of international accounting standards removes this constraint and the incentives of the acquisition and the interests of the authorities promoting the utilization of surplus funds of Japanese companies have the same direction. For this reason, large acquisitions, non-amortization of goodwill and impairment are repeatedly generated. It can be said that this is generally considered to be a reversal that the Japanese standard is conservative accounting and therefore does not match investment promotion.

This paper theoretically showed that conservative accounting would be for promoting investment, contrary to such general intuition, the active accounting would create excessive investment and reduce social welfare. First, although the term conservatism accounting is used ambiguously, in this paper we will make an accounting standard that applies downward bias on profits as an accounting system. Because immediate expense of R&D expenditure is decided unconditionally by accounting criteria, it does not fall under conservatism accounting in this paper. On the other hand, goodwill at the time of acquisition must be non-amortized and adopt an impairment test at the end of each period if it adopts international accounting standards. When evaluating goodwill at the end of the period, it is an accounting estimate and discretion is entered. In the case of goodwill, the downward bias of the present value of future profits is determined at discretion. In this sense, for example, it is conservative accounting in this article to make an accounting estimate by the auditor more severe.

If defining conservatism accounting in this way, the assertion of this paper would hamper incentives for investment even if strict accounting estimates on goodwill, that is, even increasing the degree of conservatism accounting, social welfare is raised to promote investment, and it is shown that management's efforts will be drawn. Below, we will discuss the previous study in Section 2, analyze by model in Section 3, and summarize Section 4 as a summary and subject to be discussed.

2. Related Literature

It was Venugopalan (2004) that modeled conservatism accounting as a binary signal. Based on this model it is applied to analysis of conservatism accounting and corporate governance, borrowing contract, profit management etc. The impact on corporate governance was handled by Caskey. J and V.Laux. V (2016), and conservative accounting analyzed how management affects reporting actions to the board of directors. Gao.Y and A. Wagenhofer (2016), on the contrary, analyzes what kind of monitoring actions the board of directors will take for management. Laux. V and Ray. K (2016) addressed how conservatism accounting affects corporate investment behavior. Li (2013) considers the impact on bank loan contracts, especially covenant clauses, by conservatism accounting. In addition, S. Kronenberg and Laux V. (2017) analyzed the relationship between conservative accounting and auditor 's damages. The binary signal model of Shannon diagram like this is used for analysis of a wide range of themes. On the other hand, Gox, R. and A. Wagenhofer (2009), theoretically treated the impairment of fixed assets. It is analyzed whether it is optimal to commit any valuation of collateral assets to creditors assuming the situation of holding assets as collateral upon procurement of external funds. Wielenberg and Scholze (2007) analyzed the amortization and impairment of fixed assets in the framework of shareholder and manager agency issues. This analysis analyzed not only depreciation and impairment as accounting rule but also what kind of depreciation method management would choose in the relationship between shareholders and management. Nishitani (2016) is a literature on a conservative accounting, a Japanese literature showing a theoretical conservative accounting by turning back from its history and by a binary model. Empirical analysis in Japan is

Makoto Nakano, Fumihisa Otsubo, Yusuke Takasu (2015), which demonstrates the relationship between unconditional conservatism and investment. In our paper, an original model was constructed based on the model of Laux, V., and K. Ray (2020). Laux and Ray (2020) analyzed the relationship between conservative accounting and investment. Intuitively, conservative accounting does not seem to encourage investment. However, it has shown that conservative accounting, on the contrary, promotes investment by giving management incentives for performance. They showed the superiority of conservative accounting by linking investment promotion and innovation. The analysis in there paper can be applied not only to investment related to innovation but also to investment in corporate acquisition or others, and can be said to be applicable to a wide range of corporate investment in general. The treatise states that θ follows a probability distribution, where θ is the situation faced by a company. In this paper, the outlook for the calculation is easy to understand by assuming a uniform distribution for the distribution of θ. It goes without saying that assuming the distribution of θ does not change the claim of Laux and Ray (2020).

3. Model

3.1 Settings

There are risk neutral shareholders and management. Management looks for investment opportunities and decides whether to make investment based on signals to be observed more privately. In this case, for example, investment is considered to be the acquisition of another company. After management executes investment, accounting system discloses information on performance. The timeline is as follows.

t = 1: Shareholders present performance-based compensation agreements to management. The extent of compensation w and conservatism accounting c is determined.

t = 2: Managements look for investment opportunities. Management decides efforts a.

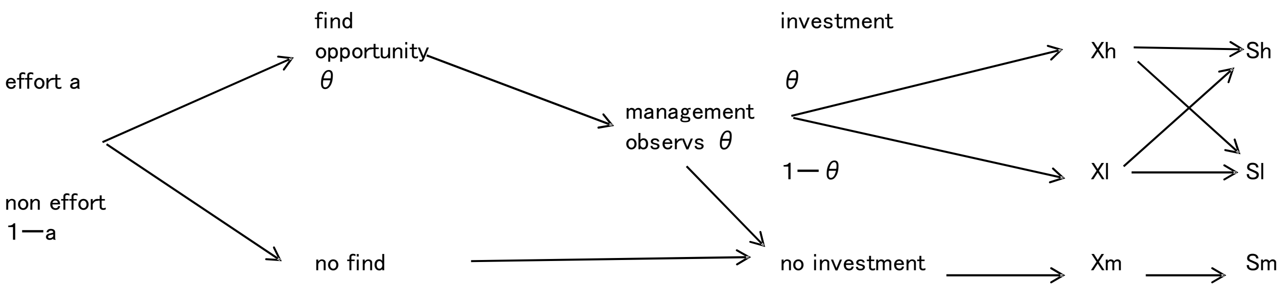
t = 3 Management will privately observe the probability of investment success or unsuccessful θ, and decide whether to execute investment or not.

t = 4: The accounting system discloses performance reports S.

t = 5: Cashflow X is confirmed.

3.2 Management Efforts and Cash Flow by Investment

Only the manager observes the probability θ of whether investment succeeds or fails. Shareholders cannot observe the efforts of management a. Management's discretion is not included in the performance report S reported by the accounting system. Management's efforts a will be within $a \in [0, 1)$, and the effort cost will be $\frac{ka^2}{2}$. Due to efforts, management finds ideas of executable investment with probability a, and does not make efforts and assumes that he cannot find ideas with a probability of $1 - a$. In other words, investment opportunities are discovered depending on whether or not management makes efforts at t = 2, and the management observes the probability θ of whether or not the investment will succeed at t = 3. If the investment is successful, cash flow X_h will occur and if it fails the cash flow will be X_l. If management does not invest, cash flow will be X_m. $X_l < X_m < X_h$ is assumed. That is, the management executes the acquisition and shows whether the acquisition causes synergies, increases cash flow, impairs and reduces cash flow, or does not invest. The situation setting is as follows.



Investment opportunities means whether managers find efforts to pursue acquisition targets. If he does not make an effort, he cannot find investment opportunities. Management finds investment opportunities and executes investment.

3.3 Signal From Accounting System

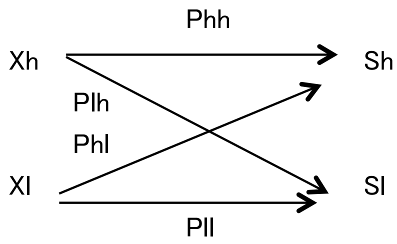
The accounting system discloses the signal of S_h, S_m, S_l, according to cash flow. If the management does not execute the investment, the cash flow will be X_m and the signal S_m will be disclosed. When investment is executed, the signal S_h or S_l is disclosed. In the accounting information system, it is assumed that perfect information is not always generated at all times, and information errors are assumed to occur probabilistically. Factors that generate information errors include the fact that valuable investment enhancing corporate value is not immediately reflected in accounting information, the existence of room for discretion in accounting information deficiencies and accounting information creation. The accounting information system will generate a signal S_i with probability $p_{ij} \equiv \Pr(S_i \mid X_j)$ when X_j, $i,j \in \{i,j\}$ is a cash flow. p_{ij} is the function of degree of conservatism accounting $c \in [\underline{c}, \overline{c}]$. If c is high, the degree of conservatism increases. Shareholders and executives can observe c. Also, the probability $p_{ij} \equiv \Pr(S_i \mid X_j)$ is differentiated with respect to c for the second order. We assume the following as accounting information system.

Assumption 1 $\frac{P_r(S|X_h)}{P_r(S|X_l)}$ increases with S for any c. $\frac{p_{hh}}{p_{hl}} > 1 > \frac{p_{lh}}{p_{ll}}$ is assumed.

Assumption 2 $\frac{dp_{lh}}{dc} > 0, \frac{dp_{ll}}{dc} > 0$

Assumption 3 $\frac{p_{hh}}{p_{hl}}, \frac{p_{lh}}{p_{ll}}$ increases with regard to c.

The following figure shows the above.



An impairment test of goodwill as a result of an acquisition determines the amount of goodwill that an auditor and management decide on an accounting estimate and is disclosed. In the model of this paper, the signal S_i will be the amount of goodwill and the stricter estimation will mean that c is larger because the degree of conservative accounting becomes stricter.

3.4 Management Behavior and Compensation

Based on the accounting signal S, shareholders present compensation agreements to management. Rewards $W = (w_h, w_m, w_l)$ shall be in accordance with accounting signals S_i. Management has bankruptcy remote and reward is positive. In addition, the reservation utility of the manager shall be zero.

Solving the maximization problem of managers' efforts and the optimization problem of shareholders given the compensation W. After the management observes the information θ about the investment, it decides whether to execute the investment or not. Each expected reward corresponding to cash flow is as follows.

$$E(w|X_h) = p_{hh}w_h + p_{lh}w_l$$
$$E(w|X_l) = p_{hl}w_h + p_{ll}w_l \quad (1)$$

High cash flow X_h results in the expectation of high signal S_h with high compensation and low signal S_l with low compensation. Low cash flow X_l results in the expected compensation as the same way. Therefore, expected compensation Ω is based upon θ and it is

$$\Omega(\theta) = \theta E(w|X_h) + (1-\theta)E(w|X_l) \quad (2)$$

θ_T is the threshold which equals compensation w_m and expected compensation when investment executed, which means,

$$\Omega(\theta_T) = \theta_T E(w|X_h) + (1-\theta_T)E(w|X_l) = w_m \quad (3)$$

This means that investment is executed under $\theta > \theta_T$ and not under $\theta < \theta_T$. Management maximizes their utility at $t = 2$. Management utility U and his compensation ψ are,

$$U = \psi - \frac{ka^2}{2} \quad \psi = a\Omega(\theta) + (1-a)w_m \quad (4)$$

First order condition with regard to effort is,

$$a = \frac{\Omega(\theta) - w_m}{k} \quad (5)$$

Cash flow based upon given management compensation is,

$$CF = a(\theta X_h + (1-\theta)X_l) + (1-a)X_m \quad (6)$$

The first term is the expected cash flow in the case of success and failure when investing in searching for investment opportunities, the second term is the expected cash flow in case of continuing the current business without looking for investment opportunities. Therefore, equity value of the company is,

$$V = \mathrm{CF} - \psi$$

Because management utility is $U = \psi - \frac{ka^2}{2}$, the above equity value is,

$$V = \mathrm{CF} - \psi = CF - (U + \frac{ka^2}{2}) \quad (7)$$

Then, in the case of first best,

$$V = \mathrm{CF} - \psi = CF - \frac{ka^2}{2} \tag{8}$$

because management utility is zero. θ_{FB} is θ of first best, then,

$$\theta_{FB} X_h + (1 - \theta_{FB}) X_l = X_m \tag{9}$$

θ_{FB} equivalates cash flow without investment and cash flow with investment. Therefore, a company will generate more cash flow through investment when $\theta > \theta_{FB}$. On the other hand, a company will produce more cash flow without investment when $\theta < \theta_{FB}$.

4. Analysis

4.1 The Case of a Given Management Compensation

First, we analyze with given compensation $W = (w_h, w_m, w_l)$. The following proposition is established on how degree of conservatism accounting influences investment execution, manager's efforts, expected compensation.

Lemma 1

Given the compensation W, if the degree c of conservatism accounting increases

1) the threshold of investment execution θ_T will increase and the possibility of investment will decline.

2) management effort will decrease and the possibility of investment will decline.

3) expected compensation will decrease.

Proof see Appendix

If the degree of conservatism increases, the manager prefers to receive moderate compensation without doing so, rather than executing investment because investment execution threshold will shift high. Since efforts are reduced, the possibility of investment execution also decreases. Furthermore, the expected reward will also be reduced in order not to make efforts. In other words, in the accounting system that uses amortization of goodwill rather than impairment accounting, the degree of conservatism increases, indicating that companies' acquisitions will not become active. However, this analysis has problems. In order to decide the optimum award agreement, you can not set θ binary as a fixed value. If θ is binary, the investment is executed when $\theta > \theta_T$ and the expected reward is Ω. On the other hand, since the investment is not executed when $\theta < \theta_T$, the management does not make an effort and the reward will be w_m. This is due to the fact that the investment is not executed in advance. In other words, if you set up a situation that you do not invest, you can observe beforehand if θ is binary, so you can compare the threshold of investment when a compensation contract is presented. Then, management can decide in advance whether investment is possible or not. Therefore, as a setting to derive the optimum compensation agreement, θ must be unobservable and be a random variable. Then, we suppose that it follows a uniform distribution of $\theta \in [0, 1]$. We analyze how the degree of conservative accounting affects investment execution when investment execution is unobservable to management.

4.2 Optimal Compensation Contract

First, we derive optimal compensation contracts for shareholders. Next, we derive the threshold of investment execution under optimal compensation contract. In the previous section, management compensation was exogenously determined and given, but in this section we decide the compensation to maximize shareholders' utility. The following proposition 1 is established for the optimum compensation contract.

Proposition 1

Optimal compensation contract is the followings;

$$w_h^* = \frac{ak}{(p_{hh} - p_{hl})(1/2 - \theta_T)} \quad w_m^* = (\theta_T p_{hh} + (1-\theta_T) p_{hl}) w_h^* \quad w_l^* = 0$$

$$\theta_T < 1/2$$

Since the level of the first best is 1/2 or less, the probability of being achieved is 50% or less, which can be said to be a realistically reasonable level assumption.

Proof see Appendix

Shareholders will be able to draw management's efforts by increasing the compensation w_h and w_m. At the same time, the threshold of investment execution increases. However, with optimal compensation, efforts will be less than efforts at first best, and the threshold for investment execution will be below the first best.

The following proposition 2 shows this.

Proposition 2

Optimal contract is

$$a^* < a^{FB}$$

$$\theta_T^* < \theta^{FB}$$

Proof see Appendix

Proposition 2 asserts that managers' efforts and the possibility of investment execution do not exceed first-best even if seeking equilibrium under optimal compensation agreements. Therefore, when increasing the degree of conservatism accounting, we analyze management's efforts and the possibility of investment execution.

4.3 The Effect of Conservatism Accounting to Optimal Compensation Contract

Proposition 3 asserts that by increasing the degree of conservatism accounting, it is possible to increase management's efforts in optimal compensation contracts, and the possibility of investment execution.

Proposition 3

As degree c of conservatism accounting increases,

1) θ_T^* increases, the area of investment execution decreases.

2) a^* increases management's efforts a^*.

3) enterprise value v increases.

θ_T^*, a^* is the threshold of investment execution and management's effort level when shareholders present optimum compensation contract.

Proof see Appendix

By deciding compensation w_h^* for management, increasing degree of conservatism accounting c can make manager's efforts higher than the level determined by optimal compensation. In addition, corporate value also increases as management's efforts and investment threshold approach closer to the first best. This result is opposite to the result of Lemma 1.

5. When Evaluating a Compensation Contract With an Accounting Signal

Up to the previous section, the compensation contract was based on the probability of disclosure of accounting information based on profit information. Then, management's expectation compensation is (1),

$$E(w|X_h) = \Pr(S_h|X_h)\, w_h + \Pr(S_l|X_h)\, w_l$$
$$E(w|X_l) = \Pr(S_h|X_l)\, w_h + \Pr(S_l|X_l)\, w_l$$

The probability of calculating the expected value is the probability of the accounting information based on the profit information. The following formula,

$$E(w|X_h) = \Pr(S_h|X_h)\, w_h + \Pr(S_l|X_h)\, w_l$$

means that the expected compensation is calculated with the probability that the accounting system outputs accounting information S_h S_h when it is X_h and the probability that the accounting system outputs accounting information S_l when X_h. Management is supposed to know the profit information. However, when shareholders decide compensation, shareholders can not know the profit information. Therefore, the accounting information disclosed will predict profit information. Then, it can be said that the probability that the expected reward calculated is the Bayes probability instead of the prior probability is more realistic. Because managers know that managing Bayesian estimation by disclosing accounting information, shareholders calculate the expected compensation based on Bayesian estimation. The influence of each a posteriori probability and degree of conservatism accounting is as follows. The posterior probability is assumed to be small letter p, and the Bayes probability is assumed to be large letter P.

$$P_{hh} = \frac{p_{hh}\int_{\theta T}^{1}\theta d\theta}{p_{hh}\int_{\theta T}^{1}\theta d\theta + p_{hl}\int_{\theta T}^{1}(1-\theta)d\theta} = \frac{\frac{P_{hh}}{P_{hl}}}{\frac{P_{hh}}{P_{hl}} + \frac{\int_{\theta T}^{1}(1-\theta)d\theta}{\int_{\theta T}^{1}\theta d\theta}} = \frac{(1+\theta T)P_{hh}}{P_{hh}+\theta T P_{hh}+P_{hl}-\theta T P_{hl}} \quad (10)$$

When the degree of conservatism accounting increases in the case of high accounting information output, the conditional probability of predicting high cash flow increases.

$$\frac{dP_{hh}}{dc} = \frac{(-1+\theta_T^2)(-p_{hl}p'_{hh} + p_{hh}p'_{hl})}{(p_{hh}+\theta_T p_{hh}] + p_{hl} - \theta_T p_{hl})^2} > 0$$

Likewise, when low accounting information comes out, the probability of inferring low cash flow is as follows.

$$P_{ll} = \frac{(1+\theta_T)p_{ll}}{p_{lh}-\theta_T p_{lh}+p_{ll}+\theta_T p_{ll}} \quad (11)$$

As the degree of conservative accounting increases, the probability of predicting low cash flows decreases when low accounting information is output. Because the level of conservative accounting is more severe, shareholders think that it will be low accounting information even with high cash flow.

$$\frac{dP_{ll}}{dc} = \frac{(-1+\theta_T^2)(p_{ll}p'_{lh} - p_{lh}p'_{ll})}{(p_{lh}-\theta_T p_{lh}+p_{ll}+\theta_T p_{ll})^2} < 0$$

Expected compensation differs from that using prior probability in case of Bayesian estimation. Probability is based on Bayesian estimation.

$$E(w|X_h) = \Pr(X_h|S_h)\, w_h + \Pr(X_l|S_h)\, w_l \quad (12)$$

$$\mathrm{E}(\mathrm{w}|X_l) = \Pr(X_h|S_l)\, w_h + \Pr(X_l|S_l)\, w_l$$

Then,

$$\mathrm{E}(W_h) = P_{hh}W_h + P_{hl}W_l$$
$$\mathrm{E}(W_l) = P_{lh}W_h + P_{ll}W_l$$
$$\Omega = \theta\mathrm{E}(W_h) + (1-\theta)\mathrm{E}(W_l)$$

Since the threshold of θ as to whether to execute investment or not to execute is equal to the reward when the expected compensation does not execute investment,

$$\Omega - W_m = 0 \tag{13}$$

Then,

$$\theta_T = \frac{-W_h+W_m+W_hP_{hh}-W_lP_{ll}}{-W_h+W_l+2W_hP_{hh}-2W_lP_{ll}} \tag{14}$$

Management's compensation by shareholders is given as $\theta_T \equiv T$

$$\psi = a\left(\int_T^1 \Omega \mathrm{d}\theta + TW_m\right) + (1-a)W_m \tag{15}$$

Management effort is

$$a = \frac{1}{k}\int_T^1 (\Omega - W_m)\mathrm{d}\theta = -\frac{(-1+T)(W_h-TW_h+W_l+TW_l-2W_m+2TW_hP_{hh}-2TW_lP_{ll})}{2k} \tag{16}$$

5.1 When Compensation Is Given

Consider the case where the compensation is determined exogenously. In the proof of Lemma 1, a posteriori probability was used in computing the manager's expected reward. In the setting in this section, shareholders make a Bayes estimation on profit based on accounting information disclosed by management, and set a compensation framework. Therefore, it is possible to analyze the calculation of the expected reward in the previous section by using the Bayesian probability instead of the posterior probability. In the case of Bayesian estimation of manager's compensation based upon accounting information, the following proposition is shown corresponding to lemma 1.

Proposition 4

Given the compensation, if the degree c of conservatism accounting increases,

1. the threshold of investment execution will decrease and the possibility of investment will increase.
2. management effort will increase and the possibility of investment will increase.
3. expected compensation will increase.

Proof see Appendix

This result is different from the result of Lemma 1. If reward is given exogenously, as the degree of conservatism accounting increases, the possibility of investment increases. Furthermore, when shareholders estimate compensation based on Bayes probability, management considers that if conservative accounting strengthens, management will strive to the contrary. In addition, expected compensation also increases. That is, the situation of excessive investment occurs.

5.2 When Reward Is Taken as Optimal Compensation

In proposition 4, when shareholders estimate management compensation from Bayesian estimation rather than accounting information, increasing the degree of conservatism accounting raises the possibility of investment, management will make efforts and increase expected management compensation. Therefore, as in 4.2, we decided the optimum compensation and then analyzed the case where the degree of conservative accounting was increased in this section. Proposition 5 insists on the same result as Proposition 3.

Proposition 6

As the degree c of conservatism accounting increases,

1) θ_T^* increases, the area of investment execution decreases.

2) management's efforts $a*$ increases.

3) enterprise value v increases.

θ_T^*, a^* is the threshold of investment execution and management's effort level when shareholders present optimum compensation contract.

Proof see Appendix

If the degree of conservative accounting is strengthened after the shareholders decide the optimal compensation, the area of investment execution will decrease and management will strive to avoid excessive investment and the corporate value will increase. In other words, if shareholders decide in advance as optimal reward when guessing true profit, whether using a posteriori probability or a Bayesian probability, by strengthening the degree of conservatism accounting, it is possible to draw out the efforts of management, and also to increase the corporate value.

6. Conclusion

This paper analyzed how conservatism accounting affects investment execution and management 's efforts. Conservative accounting discloses accounting information by biasing downwards information. Therefore, intuitively, the investment will decrease, and it is considered that management will not make an effort. However, the analysis of this paper, on the contrary, strengthens the degree of conservatism accounting, so that managers look for more investment opportunities, execute investment, make more efforts, and as a result, corporate value increases and shareholders It will show that it will result.

Conservative accounting in this paper covers events that disclose it as accounting information with the discretionary bias down to the profit. As an event dealt with in this paper, one of the examples of which are, evaluating goodwill by making an accounting estimate tight by an impairment test. An accounting estimate for goodwill is a matter of Key Audit Matter that can be negotiated between executives and auditors in Europe. In light of the assertion that managers hesitate to make accounting estimates tighter, the assertion of this paper presents the opposite result to the claim that tightening hinders promotion of acquisition. If you do not raise the degree of conservatism accounting, excessive investment will be done, so management will carry out excessive investment with the risk of impairment in the future. However, by combining management compensation and raising the degree of conservative accounting, it is possible to draw management's efforts and bring it closer to the first best.

The challenges in this paper is to make shareholders and managers risk neutral, so that compensation contracts are simply linked to profits, that the possibility of discovering investment is assumed to be uniform distribution. These points are future study subjects in carrying out a more detailed analysis. We see a lot of examples of acquisition. Then, empirical analysis based upon this model should be needed.

References

Caskey J. and Laux V. (2016). "Corporate governance, accounting conservatism, and manipulation", *Management Science.*

Laux V. and K. Ray. (2020). "Effects of accounting conservatism on investment efficiency and innovation", *Journal of Accounting and Economics*, Vol. 70, No. 1.

Gox R. and Wagenhofer A. (2009). "Optimal impairment rules", *Journal of Accounting and Economics*, Vol. 48, No. 1.
Li J. (2013). "Accounting conservatism and debt contracts: Efficient liquidation and covenant renegotiation", *Contemporary Accounting Research*, Vol. 30, No. 3, pp. 1082-1098.
Venugopalan R. (2004). "Conservatism in accounting: Good or bad?", working paper, University of Chicago.
Yanmin Gao and Alfred Wagenhofer (2013). "Accounting conservatism and board monitoring", in: *AAA 2013 Management Accounting Section (MAS) Meeting*.
Sebastian Kronenberger and Volker Laux (2017). "On the litigation explanation for conservatism", working paper.
Makoto Nakano, Fumitaka Otsubo, Yusuke Takasu (n.d.). "The effect of conservatism accounting to investment performance, risk taking and shareholder value", Kinyu Kenkyu BOJ/2015.1.
Junpei Nishitani (2015). *Conservatism Dillemma*, Chuo Keizai Publishing.

Appendix

Lemma 1

Through $\Omega(\theta) - w_m = 0$ and $E(w|X_h)$, $E(w|X_l)$, we can solve θ_T as

$$\theta_T = \frac{-w_h + w_m + p_{ll}(w_h - w_l)}{(w_h - w_l)(p_{hh} + p_{ll} - 1)} \quad \text{(A1)}$$

Then,

$$\frac{\partial \theta_T}{\partial c} = \frac{(w_h - w_m - (w_h - w_l)p_{ll})\frac{dp_{hh}}{dp_c} + (w_l - w_m + (w_h - w_l)p_{hh})\frac{dp_{ll}}{dp_c}}{(w_h - w_l)(p_{hh} + p_{ll} - 1)^2} = -\frac{\theta_T \frac{dp_{hh}}{dc} + (1-\theta_T)\frac{dp_{hl}}{dc}}{p_{hh} - p_{hl}} > 0 \quad \text{(A2)}$$

With regard to management effort,

$$\frac{\partial a}{\partial c} = \frac{(w_h - w_l)(\theta \frac{dp_{hh}}{dc} - (1-\theta)\frac{dp_{ll}}{dc}}{k} < 0 \quad \text{(A3)}$$

With regard to management compensation,

$$\frac{\partial \Psi}{\partial c} = \frac{2(w_h - w_l)(w_h - w_m - w_h\theta + w_l\theta + (w_h - w_l)(\theta p_{hh} - (1-\theta)p_{ll})(\theta \frac{dp_{hh}}{dc} - (1-\theta)\frac{dp_{ll}}{dc})}{} = 2\frac{da}{dc}ka < 0 \quad \text{(A4)}$$

Proposition 1

We assume θ as uniform distribution. Therefore, investment is executed when $\theta \in [\theta_T, 1]$. Management effort should be

$$a = \frac{1}{k}\int_{\theta_T}^{1} (\Omega - w_m)\, d\theta \quad \text{(A5)}$$

Then,

$$a = \frac{(1-\theta_T)^2 (p_{hh}w_h - p_{hl}w_h + w_l(p_{lh} - p_{ll}))}{2k} \quad \text{(A6)}$$

This should be

$$w_h - w_l = \frac{2ak}{(p_{hh} - p_{hl})(1-\theta_T)^2} \quad \text{(A7)}$$

We put the above into w_m, then,

$$w_m = \frac{\theta_T + \dfrac{p_{hl}}{p_{hh} - p_{hl}}}{(1-\theta_T)^2} ak + w_l \tag{A8}$$

This shows that we can minimize w_m when $w_l = 0$, which means optimal management compensation. Then, we have optimal w_h^*, w_m^*. Management expected compensation Ψ is,

$$\Psi = a^2 k + \frac{\theta_T + \dfrac{p_{hl}}{p_{hh} - p_{hl}}}{(1-\theta_T)^2} ak + w_l \tag{A9}$$

Proposition 2

Firm value *V* is expected cash flow *CF* subtracted management expected compensation Ψ, then, $V = CF - \psi$. Expected *CF* is the expectation of cash flow with effort and without effort,

$$CF = a\left(\int_{\theta_T}^{1} (\theta X_h + (1-\theta) X_l)\, d\theta + F(\theta_T) X_m\right) + (1-a) X_m \tag{A10}$$

First term is the sum of expected cash flow under $\theta \in [\theta_T, 1]$ and expected cash flow under $\theta \in [0, \theta_T]$. Under $\theta \in [0, \theta_T]$, profit will be X_m with probability $F(\theta_T)$ even if management makes an effort. Second term is the realized profit X_m under no management effort. We use Ψ from Proposition 2 to calculate v, then,

$$v = \int_{\theta_T}^{1} (\theta X_h + (1-\theta) X_l - X_m)\, d\theta + X_m - ka^2 - \frac{\theta_T + \dfrac{p_{hl}}{p_{hh} - p_{hl}}}{1/2 - \theta_T} ak \tag{A11}$$

$$= -a^2 k + \frac{X_h}{2} + \frac{X_l}{2} - X_l\theta_T + X_m\theta_T - \frac{X_h\theta_T^2}{2} + \frac{X_l\theta_T^2}{2} - \frac{ak(\theta_T + \dfrac{p_{hl}}{p_{hh} - p_{hl}})}{1/2 - \theta_T}$$

Taking the firest derivatec with regard to θ_T yields,

$$\frac{\partial V}{\partial \theta_T} = X_m - X_l(1-\theta_T) - X_h\theta_T - \frac{2ak}{(1-2\theta_T)^2} - \frac{4akp_{hl}}{(1-2\theta_T)^2(p_{hh} - p_{hl})}$$

From $X_m = \theta_{FB} X_h + (1-\theta_{FB}) X_l$, $(X_h - X_l)(\theta_{FB} - \theta_T^*) = \frac{2ak}{(1-2\theta_T)^2} \frac{4akp_{hl}}{(1-2\theta_T)^2(p_{hh} - p_{hl})}$

Then, $\theta_{FB} > \theta_T^*$. Taking derivative about *V* with regard to management effort a yields

$$\frac{\partial V}{\partial a} = \frac{1}{2}\left(-4ak + X_h + X_l - 2X_m - 2X_l\theta_T + 2X_m\theta_T - X_h\theta_T^2 + X_l\theta_T^2 - \frac{4k(\theta_T + \dfrac{p_{hl}}{p_{hh} - p_{hl}})}{1-2\theta_T} \right)$$

From $a_{FB} = \frac{\theta_{FB} X_h + (1-\theta_{FB}) X_l - X_m}{k}$, firm value is maximized by a^* which is

$$a^* = \frac{\theta_T^* X_h + (1-\theta_T^*) X_l - X_m - \dfrac{k\left(\dfrac{p_{hl}}{p_{hh} - p_{hl}} + \theta_T\right)}{\theta_T^* - \theta_T}}{2k} < \frac{\theta_T^* X_h + (1-\theta_T^*) X_l - X_m}{2k} < \frac{a_{FB}}{2} < a_{FB} \tag{A12}$$

This shows that a^* is lower than a_{FB} which satisfies the first best. Similaray, taking the second derivatie with regard to a and θ_T^2 yields,

$$\frac{\partial^2 v}{\partial a^2} = -2k < 0$$

$$\frac{\partial^2 v}{\partial \theta_T^2} = -X_h + X_l + \frac{8ak}{(-1+2\theta_T)^3} + \frac{16akp_{hl}}{(-1+2\theta_T)^3(p_{hh} - p_{hl})} < 0$$

Propositon 3

Taking θ_T^* with regard to c yields,

$$\frac{\partial^2 v}{\partial\theta_T\partial c}=\frac{4ak(p_{hl}\frac{dp_{hh}}{dc}-p_{hh}\frac{dp_{hl}}{dc})}{(1-2\theta_T^2)(p_{hh}-p_{hl})^2}\quad \frac{\partial^2 v}{\partial a\partial c}=\frac{2k(-p_{hl}\frac{dp_{hh}}{dc}+p_{hh}\frac{dp_{hl}}{dc})}{(-1+2\theta_T)(p_{hh}-p_{hl})^2}$$

By using implicit theorem,

$$\frac{\partial\theta_T^*}{\partial c}=-\frac{\frac{\partial^2 v}{\partial\theta_T\partial c}}{\frac{\partial^2 v}{\partial\theta_T^2}}>0\quad \frac{\partial a}{\partial c}=-\frac{\frac{\partial^2 v}{\partial a\partial c}}{\frac{\partial^2 v}{\partial a^2}}>0 \tag{A13}$$

Taking $a*$ with regard to c yields,

$$\frac{\partial a^*}{\partial c}=\frac{-p_{hl}\frac{dp_{hh}}{dc}+p_{hh}\frac{dp_{hl}}{dc}}{(-1+2\theta_T)(p_{hh}-p_{hl})^2}>0 \tag{A14}$$

Expected compensation Ψ is,

$$\Psi=ka^2+\left(\theta_T+\frac{p_{hl}}{p_{hh}-p_{hl}}\right)\left(\frac{ak}{1/2-\theta_T}\right)$$

Firm value v equals cash flow subtracted expected compensation Ψ,

$$V(a,\theta_T,c)=CF(a,\theta_T)-\Psi(a,\theta_T,c)$$

By using envelop theorem with regard to both θ_T^* and a^*, firm value V yields

$$\frac{dV(c)}{dc}=\frac{\partial V(a,\theta_T^*,c)}{\partial c}\bigg|_{\theta_T^*=0,a^*=0}=-\frac{\partial\Psi}{\vartheta c}$$

$$\frac{\partial\Psi}{\partial c}=\frac{2ak\left(p_{hl}\frac{dp_{hh}}{dc}-p_{hh}\frac{dp_{hl}}{dc}\right)}{(2\theta_T-1)(p_{hh}-p_{hl})^2}<0$$

Then,

$$\frac{dV(c)}{dc}>0$$

Proposition 4

In the case of Bayesian probability, it becomes as follows. Lemma 1 adds Bayesian probability instead of posterior probability.

$$\frac{\partial\theta_T}{\partial c}=-\frac{\theta_T\frac{dP_{hh}}{dc}+(1-\theta_T)\frac{dP_{hl}}{dc}}{P_{hh}-P_{hl}}$$

Numerator is positive, because $\frac{dP_{hh}}{dc}>0\ \frac{dP_{ll}}{dc}<0\ \frac{dP_{lh}}{dc}<0\ \frac{dP_{hl}}{dc}>0$. Denominator is,

$$P_{hh}-P_{hl}=\frac{(-1+2\theta_T-\theta_T^2+p_{hh}-2\theta_Tp_{hh}+\theta_T^2p_{hh}+p_{ll}-2\theta_Tp_{hh}p_{ll}+\theta_T^2p_{ll}+4\theta_Tp_{hh}p_{ll})}{((1-\theta_T+p_{hh}+\theta_Tp_{hh}-p_{ll}+\theta_Tp_{ll})(1-\theta_T-p_{hh}+\theta_Tp_{hh}+p_{ll}+\theta_Tp_{ll}))}$$

which is positive. Therefore $\frac{\partial\theta_T}{dc}<0$. As the degree c of conservatism accounting increases, the possibility of investment decreases. This result has the same result as Lemma 1. Similarly, from the proof of Lemma 1,

$$\frac{\partial a}{\partial c}=\frac{(w_h-w_l)(\theta_T\frac{dP_{hh}}{dc}-(1-\theta_T)\frac{dP_{ll}}{dc})}{P_{hh}-P_{hl}}>0$$

because the numerator and denominator are positive. Therefore, as the degree of conservatism accounting increases, the effort increases, which is opposite to the result of Lemma 1. From the proof of Lemma 1, $\frac{\partial\psi}{\partial c}=2\frac{da}{dc}ka$. Expected compensation increases as the level of conservatism accounting increases.

Propositon 5

The optimal management compensation determined by proposition 2 is not affected by posterior probability or Bayesian probability. Therefore, you can check whether Proposition 3 is established under Bayesian estimation. From the proof of proposition 4, when evaluating by Bayes probability,

$$\frac{\partial^2 v}{\partial\theta_T\partial c}=\frac{4ak(p_{hl}\frac{dp_{hh}}{dc}-p_{hh}\frac{dp_{hl}}{dc})}{(1-2\theta_T^2)(p_{hh}-p_{hl})^2}\quad \frac{\partial^2 v}{\partial a\partial c}=\frac{2k(-p_{hl}\frac{dp_{hh}}{dc}+p_{hh}\frac{dp_{hl}}{dc})}{(-1+2\theta_T)(p_{hh}-p_{hl})^2}$$

$$\frac{dP_{hh}}{dc}>0\,\frac{dP_{ll}}{dc}<0\;\frac{dP_{lh}}{dc}<0\,\frac{dP_{hl}}{dc}>0$$

We will see the sign of denominator,

$$P_{hl}\frac{dP_{hh}}{dc}-P_{hh}\frac{dP_{hl}}{dc}$$

the denominator of the above is

$$((1+\theta_T)p_{hh}+(-1+\theta_T)(-1+p_{ll}))^2((-1+\theta_T)(-1+p_{hh})+(1+\theta_T)p_{ll})^2$$

This is positive. The numerator of the above is

$$-((-1+\theta_T)(1+\theta_T)(((-1+\theta_T)^2(-1+p_{hh})^2$$
$$+2(-(-1+\theta_T)\theta_T+p_{hh}((-1+\theta_T)^2+2\theta_T p_{hh}))p_{ll}+(-1+\theta_T^2)p_{ll}^2)p'_{hh}-2(-1+p_{hh})p_{hh}(1-\theta_T+2\mathrm{v}p_{hh})p'_{ll}))$$

which is positive. Then,

$$\frac{\partial^2 v}{\partial\theta_T\partial c}=\frac{4ak(p_{hl}\frac{dp_{hh}}{dc}-p_{hh}\frac{dp_{hl}}{dc})}{(1-2\theta_T^2)(p_{hh}-p_{hl})^2}<0\quad \frac{\partial^2 v}{\partial a\partial c}=\frac{2k(-p_{hl}\frac{dp_{hh}}{dc}+p_{hh}\frac{dp_{hl}}{dc})}{(-1+2\theta_T)(p_{hh}-p_{hl})^2}>0$$

And we have,

$$\frac{\partial^2 v}{\partial a^2}=-2k<0\quad \frac{\partial^2 v}{\partial\theta_T^2}=-X_h+X_l+\frac{8ak}{(-1+2\theta_T)^3}+\frac{16akp_{hl}}{(-1+2\theta_T)^3(p_{hh}-p_{hl})}<0$$

By using implicit theorem,

$$\frac{\partial\theta_T^*}{\partial c}=-\frac{\frac{\partial^2 v}{\partial\theta_T\partial c}}{\frac{\partial^2 v}{\partial\theta_T^2}}>0\quad \frac{\partial a}{\partial c}=-\frac{\frac{\partial^2 v}{\partial a\partial c}}{\frac{\partial^2 v}{\partial a^2}}>0 \tag{A15}$$

And we have,

$$\frac{\partial a^*}{\partial c}=\frac{-p_{hl}\frac{dp_{hh}}{dc}+p_{hh}\frac{dp_{hl}}{dc}}{(-1+2\theta_T)(p_{hh}-p_{hl})^2}>0 \tag{A16}$$

Then,

$$\frac{dV(c)}{dc}=\frac{\partial V(a,\theta_T^*,c)}{\partial c}\bigg|_{\theta_T^*=0,a^*=0}=-\frac{\partial\Psi}{\vartheta c}$$

$$\frac{\partial\Psi}{\partial c}=\frac{2ak\left(p_{hl}\frac{dp_{hh}}{dc}-p_{hh}\frac{dp_{hl}}{dc}\right)}{(2\theta_T-1)(p_{hh}-p_{hl})^2}<0$$

which results in

$$\frac{dV(c)}{dc}>0$$