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Credit Rationing, Earnings Manipulation, and Renegotiation-Proof Contracts*

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Abstract

This paper considers the situation where a manager borrows funds from an investor and carries out a long-term project entailing a credit rationing problem. If the manager has a myopic preference, the credit rationing problem will be compounded by renegotiation depending on the earnings signal. The paper also compares a transparent accounting system and an opaque one. If the parties can renegotiate the initial contract, the credit rationing problem will be alleviated more in the opaque system than in the transparent one.

本稿は、近視眼的な経営者が投資家との間で資金借り入れの契約を締結して長期プロジェクトを実行する際に、信用割当問題が発生する状況を考察している。経営者と投資家の時間選好率が異なる場合であって、約定後に中間期の利益予想に基づいた再交渉が可能であるときには、再交渉が不可能な場合に比べて信用割当問題が悪化する可能性を示す。さらに、成功確率は低いが、利益予想に関するシグナルの精度が十分に高いプロジェクトの場合には、経営者が投資家に対してシグナルを提供しないことによって、かえって信用割当問題が改善する可能性があることを示す。

Keywords: Credit rationing; Earnings manipulation; Renegotiation; Managerial myopia

JEL classification: D82, E51, G34, J33

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1 Introduction

As a result of many accounting scandals by well-known firms in recent years the transparency of accounting information has been discussed. In such discussions, there is a general presumption that higher transparency of accounting information alleviates the agency problem and is beneficial to the credit market. It may be true in many situations.

However, some economic theories suggest that this is not always the case. Axelson and Baliga (2009) find that an opaque financial system sometimes attains an improved allocation. They investigate a situation where a manager has a long-term project entailing moral hazard, and an investor puts her funds in it. After the moral hazard stage, manager obtains an earnings signal regarding the outcome of the long-term project. Axelson and Baliga (2009) define a *transparent* accounting system as the situation where both parties can observe the signal. On the other hand, they define an *opaque* one as the situation where only the manager can observe the signal. Then, if the parties can renegotiate the initial contract depending on the signal, the opaque system can sometimes alleviate a credit rationing problem compared to the transparent one by using the logic of Akerlof's lemon market.

Axelson and Baliga (2009) did not examine the credit rationing problem. Hence, this study extends the model of Holmstrom and Tirole (1996) to a two-period model, and introduces the logic of Axelson and Baliga (2009). Then, we can know that the logic of Axelson and Baliga (2009) does not always hold for a credit rationing problem. However, we find that the opaque system is better for the parties under the conditions that the probability of success is low but the precision of the signal is high enough.

Our opaque policy suits the drug discovery industry. It is difficult to judge whether research and development of a drug will be successful at the time of initial investment. However, we have strong technology for the clinical test. This can be interpreted as an earnings signal, that is, we have a high-precision signal. In this industry, an opaque system will be better than a transparent one.

2 The Model

A manager has a long-term project which requires fixed investment I. He also has asset $A < I$ initially. To implement the project, the manager must borrow $I - A$ from an investor. The long-term project yields verifiable income $R > 0$ in the case of success or no income in the case of failure. The probability of success regarding the project is determined by the manager's unobservable behavior $e \in \{b, m\}$. Behaving $(e = b)$ yields

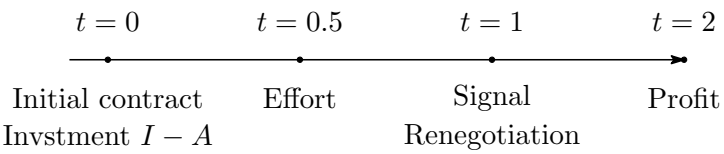

Figure 1: Timeline

probability $p_s > 0$ of success and no private benefit to the manager. Misbehaving ($e = m$) leads to zero profit with certainty but yields private benefit B to the manager.

We assume that the manager and the investor are risk neutral. However, they differ in terms of patience. The investor is indifferent between early and late consumption, that is

$$u_I(c_1, c_2) = c_1 + c_2, \tag{1}$$

where c_t is the consumption at period $t \in \{1, 2\}$. On the other hand, the manager is impatient, that is,

$$u_E(c_1, c_2) = c_1 + \beta c_2, \quad \text{where } 0 < \beta < 1. \tag{2}$$

We can take β for the opportunity cost of the manager as in Aghion et. al. (2004), or Axelson and Baliga (2009)[1].

We assume that $pR - I > 0 = B - I$ for simplicity. Hence, the project has a positive net present value if the manager behaves, but has zero if the manager misbehaves. This means that, as long as the manager behaves, it is preferable to carry out the project socially. Additionally, we set $p(R|b)R < \frac{1+\beta}{\beta} I$ for the technical requirement.[2]

After the manager chooses his effort, but before the profit is realized, the manager receives signal $s \in \{h, \ell\}$ regarding the profit. Conditional on profit, the signal is distributed as follows:

$$p(h|y = R) = p > \frac{1}{2}, \qquad p(\ell|y = R) = 1 - p$$
$$p(h|y = 0) = 1 - p, \qquad p(\ell|y = 0) = p > \frac{1}{2}$$

where $p \in (0, 1)$.

[1]For example, consider the situation where the idea occurs to the manager at $t = 1$. If the $t = 1$ compensation scheme is not designed to transfer the money from the investor to the manager, the manager loses an opportunity to carry out the new project. This cost is measured by β. On the other hand, we will assume that the investor has all of the bargaining power in this paper. So it is natural that she has the many investment project constantly. That is, there is no opportunity cost for the investor; $\beta = 1$. Another way to interpret β concerns the inefficiency of money. If the investor transfers one dollar both $t = 1, 2$, then the payoff of $t = 1$ is bigger than that of $t = 2$. That is, $t = 2$ transfer has inefficiency.

[2]If the expected profit is so high, it is always optimal to implement the project. To focus on interesting situations, we impose this assumption.

The investor receives profit R in compensation for his investment, and pays transfers w_1 at $t = 1$ and w_2 at $t = 2$ to the manager.

Here, we define the types of contracts for sharing the project's profit. We assume that if the project will be a success, once the investor receives all profit R in compensation for investment, and she will pay transfers w_1 at $t = 1$ and w_2 at $t = 2$ to the manager for encouraging his effort. Moreover, we define the contract $w_1 > 0$ and $w_2 = 0$ as a short-term contract, $w_1 = 0$ and $w_2 > 0$ as a long-term contract, and $w_1 > 0$ and $w_2 > 0$ as a mixed contract. Through this paper, we assume that the manager is protected by limited liability in all kinds of contract forms.

Finally, the timeline is as follow: (1) the parties sign an initial contract, (2) the manager puts effort into the project, (3) the earnings signal is realized, and if possible, the investor offers a new contract, and (4) the output is realized and the parties carry out the agreed contract.

3 Full-Commitment Benchmark

Assume that the investor as well as the manager can observe signal s and that the initial contract cannot be renegotiated. The investor can use the two types of information: signal and output. Hence, the contract can be written by $\{w_1(s), w_2(y, s)\}_{s\in\{\ell,h\},y\in\{0,R\}}$. Assume that the investor has all of the bargaining power. Hence we solve for the contract problem that minimizes the investor's payoff subject to the manager's incentive-compatible constraint, limited-liability constraint, and both parties' participation constraint.[3]

Note that the optimal contract problem should be based on $\{w_1(s), w_2(y, s)\}_{s\in\{\ell,h\},y\in\{0,R\}}$. However, we can easily show that it is sufficient to think only about $\{w_1(h), w_2(R)\}$.[4] Then, the problem is

$$\min_{w_1(h),w_2(R)} \; p(h|b)w_1(h) + p(R|b)w_2(R) \tag{3}$$

$$\text{s.t.} \quad p(h|b)w_1(h) + \beta p(R|b)w_2(R) \geq p(h|m)w_1(h) + B \tag{ic_f}$$

$$p(R|b)R - \big[p(h|b)w_1(h) + p(R|b)w_2(R)\big] \geq I - A \tag{ir_f}$$

$$w_1(h) \geq 0, \; w_2(R) \geq 0. \tag{ll}$$

The lowest level that encourages the manager to behave is (w_1^*, w_2^*) and it satisfies the binding case of (ic_f) . Note that this system is linear so that the solutions are one of two

[3]We assume $B = I$. Then, we can easily show that the manager's participation constraint is always satisfied. So, we can neglect this constraint.

[4]See Axelson and Baliga (2009).

extremes, short-term contract or long-term contract. Hence, from (ic_f), short-term and long-term contracts must satisfy

$$w_1(h) \geq w_1^s \equiv \frac{B}{p(h|b) - p(h|m)} \quad \text{and} \quad w_2(R) \geq w_2^\ell \equiv \frac{B}{\beta p(R|b)}, \tag{4}$$

respectively. The expected payments from the investor to the manager are

$$w^s = p(h|b)\frac{B}{p(h|b) - p(h|m)}, \quad \text{and} \quad w^\ell = p(R|b)\frac{B}{\beta p(R|b)}. \tag{5}$$

To focus on the interesting cases, we assume that the long-term contract is cheaper than the short-term one, $w^s > w^\ell$. Equivalently,

$$\beta \geq \underline{\beta} \equiv 1 - \frac{p(h|m)}{p(h|b)}. \tag{6}$$

Then the optimal contract is $w_2^*(R) > 0$ and the other transfers are zero. Substituting the optimal contract into (ir_f) and solving for initial asset A, we have

$$A \geq A^* \equiv \frac{B}{\beta} - [p(R|b)R - I]. \tag{7}$$

If the manager has $A < A^*$ initially, then he faces credit rationing.

Because both parties are risk neutral and this initial contract is efficient from the viewpoint of risk-sharing, the parties have no incentive to renegotiate regarding risk-sharing. However, they have different level of patience. So, if the investors transfer the same amount of money to the manager, then earlier payment will improve the manager's payoff. Hence the investor may think that paying the expected value of w_2^* in advance would lower the total expected payment. This is the reason to consider the renegotiation. First we think about the renegotiation problem under a transparent accounting system, and next under an opaque system.

4 Renegotiation with a Transparent System

Suppose that, after the signal is observed by both parties, the investor can propose a new contract, that is, renegotiation occurrs. This contract is accepted by the manager if it weakly improves the manager's payoff compared to the initial contract.

Define $\{\tilde{w}_1, \tilde{w}_2\}$ as any initial contract that does not incur the moral-hazard problem. Remember that both parties are risk-neutral but the manager is more impatient than the investor. Hence, if the investor offers the new contract $w_1(s) = \beta p(\cdot|\cdot,\cdot)\tilde{w}_2(\cdot,\cdot)$ and $w_2(\cdot,\cdot) = 0$ in place of the initial contract, the manager weakly accepts it and the investor can improve her payoff. This means that $w_1(\cdot) \geq w_2(\cdot,\cdot) = 0$ is optimal. That is, only a

short-term contract is renegotiation-proof. Then, we can focus our interest on a short-term contract at the time of initial contract design.

The renegotiation-proof initial contract is the solution to the following problem:

$$\min_{w_1(s),w_2(y,s)} p(h|b)w_1(h) + p(\ell|b)w_1(\ell) \tag{8}$$

$$\text{s.t.} \quad p(h|b)w_1(h) + p(\ell|b)w_1(\ell) \geq p(h|m)w_1(h) + p(\ell|m)w_1(\ell) + B \qquad (ic)$$

$$p(R|b)R - \left[p(h|b)w_1(h) + p(\ell|b)w_1(\ell)\right] \geq I - A \qquad (ir)$$

We can easily show that the optimal contract is $w_1(h) > w_1(\ell) = 0$. Considering the incentive-compatibility constraint, the lowest transfer that encourages the manager to work is

$$w_1(h) > w_1^t(h) \equiv \frac{B}{p(h|b) - p(h|m)}. \tag{9}$$

Substituting this result into the investor's participation constraint, we have

$$A \geq A^s \equiv \frac{p(h|b)}{p(h|b) - p(h|m)}B - [p(R|b)R - I]. \tag{10}$$

Our interest concerns whether the renegotiation affects the credit rationing problem. Comparing A^s with A^*, we have $A^s > A^*$ because the long-term contract is cheaper than the short-term one. That is, the renegotiation worsens the credit rationing problem.

If the party can commit to the initial contract fully, the investor must follow it. But if the investor can offer the new contract after observing the signal, she is tempted by early payment, which lowers the total payment. This means that the renegotiation-proof initial contract is a short-term contract. Any contract except short-term contract cannot be better than a renegotiation-proof contract. Hence, it is sufficient that we focus our interest on short-term contracts only. Note that a short-term contract is more expensive than a long-term one. This means that the investor must pay more and her payoff is lower. So the investor cannot lend funds to a manager who has lower initial assets.

Proposition 1. *If the investor can offer the new contract at $t = 1$ in the case of $w_2(\cdot,\cdot) > 0$, then the investor will be tempted by early payment. So the renegotiation-proof contract should be a short-term contract, which is more expensive than a long-term one. As a result, the renegotiation-proof contract will worsen the credit rationing problem in comparison with the case of full-commitment benchmark.*

5 The Effect of Information Opaqueness

Next we consider the situation where only the manager can observe the signal, that is, the manager is not required to show his information. We assume that the manager can send

the earnings report $r \in \{h, \ell\}$. If the investor can design a contract encouraging to disclose information, this report is informative. Axelson and Baliga (2009) show that the solutions for the contract under an opaque system are (i) $w_1(h) = w_1(\ell) = \bar{R}_1$ if $w_2(R, h) = 0$, or (ii) $w_1(\ell) = w_1(h) + \beta p(R|\ell, b) w_2(R, h)$ if $w_2(R, h) > 0$.

In the case of $w_1(h) = w_1(\ell) = \bar{R}_1$, there is no incentive-compatible contract without $B = 0$. However, we can design an incentive-compatible contract if $w_2(R, h) > 0$. The problem is such that

$$\min_{w_1(\ell), w_2(R,h)} E\big[w_1(r) + w_2(y, r)\big] \tag{11}$$

$$\text{s.t.} \quad p(\ell|b)w_1(\ell) + p(h|b)w_1(h) + \beta p(R|h, b)w_2(R, h) \geq w_1(\ell) + B \qquad (ic_{oi})$$

$$p(R|b)R - \big[p(\ell|b)w_1(\ell) + p(h|b)w_1(h) + p(R|h, b)w_2(R, h)\big] \geq I - A \qquad (ir_{oi})$$

$$w_1(\ell) = w_1(h) + \beta p(R|\ell, b) w_2(R, h)$$

$$w_2(R, \ell) = w_2(0, h) = w_2(0, \ell) = 0. \qquad (rp)$$

This means that

$$w_1^{rp}(\ell) = \frac{p(R|\ell, b)}{p(\ell|b) + p(R|h, b) - p(R|\ell, b)} \tag{12}$$

$$w_2^{rp}(R, h) = \frac{1}{p(\ell|b) + p(R|h, b) - p(R|\ell, b)} \frac{B}{\beta}. \tag{13}$$

Again we can consider the credit rationing problem from the viewpoint of the investor's rationality constraint;

$$A \geq A^{rp} \equiv \frac{p(\ell|b)p(R|\ell, b) + p(R|h, b)}{p(\ell|b)p(R|\ell, b) + p(R|h, b) - p(R|\ell, b)} B - \big[p(R|b)R - I\big]. \tag{14}$$

Proposition 2. *Compared to the transparent system, the credit rationing problem will be relaxed by an opaque system if and only if $A^s < A^{rp}$, that is,*

$$\frac{p(h|m)}{p(h|b)} > \frac{p(R|\ell, b)}{p(\ell|b)p(R|\ell, b) + p(R|h, b)}. \tag{15}$$

In both systems, the investor can offer the contracts twice, (ex ante) initial contract and (ex post) renegotiation. She offers the initial contract with renegotiation in mind. In a transparent system, she can use her bargaining power fully. She knows that the renegotiation will be exercised for a long-term contract, so the renegotiation-proof contract will be a short-term contract. But, in that situation we consider that a short-term contract is more costly for the investor than a long-term one. Therefore, she requires more collateral from the manager more and a project whose investor has less initial assets will be rise efficient. On the other hand, in an opaque system, the investor cannot use her bargaining power fully because she cannot observe the signal. In renegotiation, the investor loses some

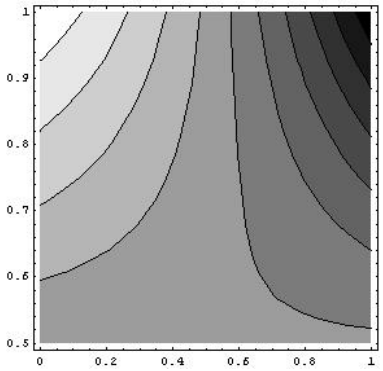

Figure 2:

bargaining power. This allows for the possibility of a long-term contract, and alleviates the credit rationing problem.

Figure 2 shows the region in which an opaque system is preferred. Then horizontal (vertical) axis represents the probability of success p_s (precision of signal p). An opaque policy is desirable when the parameters are located in the upper-left region of upward-sloping curve. That is, the probability of success is sufficiently low and the precision of the signal is high enough. Otherwise we can regard the precision of the signal as the technology for a clinical test. Then, our opaque policy will suit for drug discovery industry.

6 Conclusion

This paper has examined the credit rationing problem where the investor can offer a new contract after the manager's effort. Even though a long-term contract is cheaper than a short-term one, the investor will be tempted by renegotiation at $t = 1$ and offer a early payment in a transparent system. Then, only a short-term contract will be renegotiation-proof and costly for the investor. To cover this loss, the investor elevates the threshold of lending. That is, the credit rationing problem will be worsened. However, if the manager is not required to show his information, the credit rationing problem will be alleviated.

We assume that the investor offers both an initial contract and renegotiation. If other economic agents offer each contract, the results may change. However, we think that our example is an interesting case. Other cases will be reserved for future research.

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Appendix: The Formal Problem of Renegotiation with Transparent and Opaque Systems

Define $\{\tilde{w}_1(s), \tilde{w}_2(y,s)\}$ as any initial contract. Then, we can write the renegotiation problem under a transparent system, such that

$$\begin{aligned}
&\min_{w_1(\cdot),w_1(\cdot,\cdot)} E[w_1(s) + w_2(y,s)|e=b], \quad s \in \{\ell, h\} && (16)\\
&\text{s.t. } w_1(s) + \beta\big[p(R|s,b)w_2(R,s) + p(0|s,b)w_2(0,s)\big]\\
&\quad \geq \tilde{w}_1(s) + \beta\big[p(R|s,b)\tilde{w}_2(R,s) + p(0|s,b)\tilde{w}_2(0,s)\big] && (ir_{er})\\
&\quad w_1(s) + \big[p(R|s,b)w_2(R,s) + p(0|s,b)w_2(0,s)\big]\\
&\quad \geq \tilde{w}_1(s) + \big[p(R|s,b)\tilde{w}_2(R,s) + p(0|s,b)\tilde{w}_2(0,s)\big]. && (ir_{ir})
\end{aligned}$$

We can also write the renegotiation problem under an opaque system such that

$$\begin{aligned}
&\min_{w_1(r),w_2(y,r)} E[w_1(r) + w_2(y,r)|e=b], \quad s \in \{\ell, h\} && (17)\\
&\text{s.t.} \quad w_1(h) + \beta\big[p(R|h,b)w_2(R,h) + p(0|h,b)w_2(0,h)\big]\\
&\quad \geq \tilde{w}_1(\ell) + \beta\big[p(R|h,b)\tilde{w}_2(R,\ell) + p(0|h,b)\tilde{w}_2(0,\ell)\big] && (ic_{oh})\\
&\quad w_1(\ell) + \beta\big[p(R|\ell,b)w_2(R,\ell) + p(0|\ell,b)w_2(0,\ell)\big]\\
&\quad \geq \tilde{w}_1(h) + \beta\big[p(R|\ell,b)\tilde{w}_2(R,h) + p(0|\ell,b)\tilde{w}_2(0,h)\big] && (ic_{o\ell})\\
&\quad w_1(h) + \beta\big[p(R|h,b)w_2(R,h) + p(0|h,b)w_2(0,h)\big]\\
&\quad \geq \tilde{w}_1(h) + \beta\big[p(R|h,b)\tilde{w}_2(R,h) + p(0|h,b)\tilde{w}_2(0,h)\big] && (ir_{oh})\\
&\quad w_1(\ell) + \beta\big[p(R|\ell,b)w_2(R,\ell) + p(0|\ell,b)w_2(0,\ell)\big]\\
&\quad \geq \tilde{w}_1(\ell) + \beta\big[p(R|\ell,b)\tilde{w}_2(R,\ell) + p(0|\ell,b)\tilde{w}_2(0,\ell)\big]. && (ir_{o\ell})
\end{aligned}$$

The proofs of both problems are the same as in Axelson and Baliga (2009).

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“Credit Rationing, Earnings Manipulation, and Renegotiation, and Renegotiation-Proof Contract” に対するコメント

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本論文は、情報開示の度合、株主と経営者の間で結ばれる経営者報酬契約の形態、企業の資金制約という、一見関係のなさそうな要因の間の関係を数理モデルによって厳密に分析したものである。伝統的な企業金融理論では、資金提供者と企業の間の情報の非対称性が企業の資金制約の一因であり、開示情報の精度が上げればこの問題は解消され、資金制約は緩むとされてきたが、これに対する反例を提示している点が本論文の重要な学術的貢献である。

本論文は以下のような状況を想定している。ある企業がリスキーな長期プロジェクトを計画している。この企業の経営者が適切に努力すれば、このプロジェクトの最終的な成功確率が高くなる。経営者が努力した後、最終結果が明らかとなる前に、最終結果をほのめかす中間報告(signal)が公表される。株主は以上のことをあらかじめ想定しつつ、プロジェクト開始前に報酬契約を経営者に提示し、経営者がそれを受け入れた場合に、プロジェクトに必要な資金提供を行う。この際、株主にとって最適な提示契約は、経営者の適切な努力を引き出しつつ、株主自身の利得を最大化するような報酬契約である。このような報酬契約と企業の資金制約の関係を理論的に厳密に示すために、本論文では Axelson and Baliga (2009) の報酬契約モデルに、Hormström and Tirole (1997) の資金制約モデルを接続したモデルを用いて分析を展開している。

プロジェクト開始前に締結した報酬契約を、プロジェクト開始後に修正することができない場合 (full commitment)、論文中で想定されているパラメトリックな仮定の下での株主の最適契約は、最終結果のみに連動し、最終結果が明らかとなった後に支払われる長期契約となる。しかし、プロジェクト開始後に修正（再交渉、renegotiation）が可能であり、かつ企業家の方が株主に比べて「せっかち」である（時間選好率が高い）場合、再交渉の結果をあらかじめ織り込んだ最適契約（renegotiation-proof contract）は、中間報告のみに連動し、中間報告が明らかとなった直後、最終結果を待たずに支払われる短期契約となる。せっかちな経営者にとっては、最終時点でもらえる 1 億円よりも、中間時点でもらえる 1 億円の方が主観的な価値が大きい一方、株主の方ではそのような差が小さい。したがって、中間時点に報酬を支払う方が、

より小さい費用で経営者を動機づけすることができると株主は考える。この結果、再交渉が可能な場合は短期契約が選ばれる。

しかし、短期契約に基づく報酬は、最終結果を完全に正確には反映しない不完全な中間報告(signal) に連動しているため、努力をしなかった経営者に報酬を誤って支払う、あるいは努力した経営者に誤って報酬を支払わないなどの過誤の可能性があり、経営者の動機付けが弱くなるという欠点がある。この欠点を知る株主はそもそも最初の時点での資金提供に慎重になり、結果として企業の資金制約は厳しくなる。

短期契約となってしまうそもそもの原因は、株主側が再交渉を行う誘因を持つことにあるので、そのような誘惑を抑えることができれば、再び最終結果と連動した長期契約が選ばれ、結果として資金制約が緩むはずである。そのような工夫のひとつとして、本論文が提示しているのが、中間報告の非開示（information opaqueness）である。中間報告が非開示であれば、再交渉による契約の短期化から期待される株主利得が低く抑えられるので、長期契約が維持され、中間報告の開示がある場合よりも資金制約が緩くなる可能性を本論文は示している。

さらに、中間報告を非開示にすることでかえって資金制約が緩むのは、中間報告の精度が高く、最終的な成功可能性が低い場合であることを、本論文は数値例を用いて示している。精度の高い情報開示を行う体制が整っている上場企業が、業態転換を狙って、リスクが大きい上に時間のかかるプロジェクトを行う際に、上場企業に求められる高度な情報開示義務を避けるために Management Buy-Out などによる非上場化を選ぶことがあるが、本論文の分析結果はこのような戦略的非上場化に関する経済合理的な説明を与えていると解釈することができる。なお、本論文に限らず、最近の経営者報酬の理論モデルでは、企業家の時間選好率が資金提供者のそれよりも高いとの仮定がしばしば置かれるが、この仮定の妥当性に関する実証研究は、筆者の知る限り十分になされているとは言い難い。この点は、行動経済学的見地からの検証が求められる論点のひとつであると言えよう。

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