

## Asymmetric Information, Self Selection, and Debt

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### Abstract

The use of debt has been a continuing research subject after the irrelevance argument made by Miller and Modigliani. Two issues about debt contracts are explored in this paper: why firms use fixed-payment debt contract for external financing if it is Zrrelevant, and why debtholders have no control right. A simple explanation is offered to study the reason of this widely observed arrangement. The explanation relies on the theory of self selection from competing contracts under imperfect information. If the investors do not know the managerial ability of the firm's owner, the use of debt financing is shown to be generally better than the use of external equity financing. We find that the debt contract either drives the equity contract out of the market by revealing the bad managerial ability of the firm's owner, or is used in a self-selection scheme together with external equity contract. In this latter case, the debt contract is preferred by the firm's owner with better managerial ability, and the debtholder receives no control right of the firm. The implication of the model is consistent with the substantial use of debt in the merger and acquisition activities, and the resulting increase of the acquired firm's market value. Whenever a firm is taken over by a better management, debt issues will replace the equity issues. Meanwhile, it also contributes to our understanding of high leverage in capital structure for closely held firms. If the owner believes he/she can manage better, debt issues will be used for external financing.

**Key words:** debt contract, self selection, control right, external financing, asymmetric information

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## I. Introduction

Ever since Miller and Modigliani (1958) published their seminar irrelevance theorem of capital structure, the use of debt has been a continuing research subject in the literature. The advantage of its tax shield is an insufficient explanation of debt usage since it fails to explain the use before the introduction of corporate taxes.

Several explanations for the use of debt are provided in the literature. Jensen and Meckling (1976) show that debt contract can be used to balance the agency costs related to external equity financing. Ross (1977) demonstrates the use of debt as a signal of the quality of the firm. Higher quality firms are associated with higher debt ratio. Harris and Raviv (1988) pioneer the relationship between capital structure decisions and corporate control phenomena. They find that the use of debt is a device for incumbents to maintain valuable control of the firm.

This paper discusses another explanation for the use of debt and its control right feature. In a simple model with asymmetric information, debt contract is shown to be preferred to the equity contract by the firm. A self-selection mechanism explains why the debtholders have no control right. Meanwhile, the value of the firm increases from debt financing. The implication of the model is consistent with the substantial use of debt in the merger and acquisition activities.

The model is in line with several studies in the literature. Townsend (1979) discusses a similar model for a pure exchange economy with two agents. Preferences and endowments are such that there are gains to trading claims contingent on the realization of random returns. However, Townsend concentrates on the asymmetric feature of this random return, i.e., it is known only to one of the agent. He assumes that it can be verified through a costly process

which incurs dead-weight loss. His finding is that there exists a set of realizations over which there is no verifications, which means bonds are used.

Myers and Majluf (1984) develop an asymmetric information model in which debt is preferred by undervalued firms. Although the result in section 3 of this paper has the same feature, it is noted that the driving forces of these two models are completely different. In their model, there is asymmetric information regarding to the asset-in-place. Because of the undervaluation of this asset-in-place, debt contract is preferred. In this paper, the asymmetric information is related directly to the new project. So the result can be applied to new firms and spin-offs as well as matured, established firms.

Recently Narayanan (1988) provided an explanation for the use of debt under asymmetric information. He argues that the use of debt by profitable firms forces some unprofitable firms out of the market. The elimination of these inferior firms increases the value of the firms remaining in the market. The crucial assumption in Narayanan's model is the existence of substantial number of unprofitable firms. In the model developed below, it is assumed that all the firms are profitable, which is a situation unexplored by his model. Additionally, there is no consideration of equity financing in his model while it is considered in this model as one of the self-selection contracts used in the market.

This model consists of two players with asymmetric information in a simple economy. There are obtainable gains for the two players to participate in a joint venture. The payoff of the joint venture is affected by the managerial ability of the control party. However, one player (investor or venture capitalist) does not know the managerial ability of the other player (project owner). If the project owner controls the new venture, it is shown that a debt contract will be used for the necessary external financing. If the control right is subject to

negotiation, both equity and debt contracts are used in a self-selection scheme. The project owner with higher managerial ability chooses to control the project and use the debt contract. Those with lower managerial ability choose to use equity contract and give the control of the firm to the other player.

The paper is organized as follows. Section 2 provides the basic model. Section 3 analyzes the role of debt contract as the result of asymmetric information. In section 4, the self selection mechanism by equity and debt contracts is explored. The conclusions are given in section 5.

## II. The Basic Model

Consider an economy with two risk free players, player I and player P. Player I (an investor or capital owner) is endowed with an amount of  $K$  dollars, and player P (project owner) is endowed with a project but has no investable resources. The project requires the outside financing of  $K$  dollars as an inputs and generates random end-of-period cash flow,  $Y$ . The capital amount,  $K$ , is an exogenous variable in the model and can be viewed as the optimal investment for the project in a world of complete information. This optimal level of investment is assumed to be independent of the financing decision. We also assume that the project's rate of return is always greater than one. Therefore the incentive is present for the two players to cooperate and negotiate a contract in order to invest in the project and share the payoffs at the end of the period.

A firm is defined to be the combination of the project and the capital under a binding contract between the two players. The output of the firm,  $Y$ , is affected by the managerial ability of the control

party of the firm. Assume first that the player P, the project owner, is the incumbent control party. This scenario is one of a firm that is established by an entrepreneur (project owner) with outside financing of K dollars from an investor. The entrepreneur is the incumbent manager and the output of the firm depends on his managerial ability.

Let  $m_p$  denote the player P's managerial ability, with  $m_p$  normalized to be in  $[0,1]$ . The firm's random end-of-period cash flow Y has a cumulative distribution function  $G(Y|m_p)$  if the control agent is of ability  $m_p$ . We assume that the distributions  $G(Y|m_p)$  have common support for  $m_p$  in  $[0,1]$ . A larger value of  $m_p$  indicates higher ability in the sense that the conditional distributions  $G(Y|m_p)$  are ordered by strict first order stochastic dominance. The expected cash flow of the project under the control of player P is denoted by  $y(m_p)$  which is assumed to be continuous.

We now specify the information structure of the model. The investment K, the production function and the distributions  $G(Y|m_p)$  are assumed to be common knowledge. However, only the player P knows his own managerial ability,  $m_p$ . Let F be the objective distribution function of  $m_p$  with support  $[0,1]$ . We assume that  $m_p$  is continuously distributed in this interval.

Finally, we make the following assumptions for the general settings of the model:

- A1 : There are no taxes, no transaction costs or bankruptcy costs.
- A2 : There are no agency or moral hazard problems in the model. Whoever is in control seeks to maximize the value of the firm. Control itself has no value.
- A3 : The investor has rational expectations.
- A4 : For simplicity, the time value of money is zero. (The result won't be affected if we relax this assumption.)

### III. The Use of Debt Contracts

Our purpose here is to demonstrate the use of debt in a simple environment of asymmetric information. We restrict our attention to equity and debt contracts only. This situation can arise if the legal system is such that debt and equity are the only types of contract that can be used. The defining characteristic of debt contract is its fixed amount of promised payment, while the equity contract provides a fixed portion of the random payoff of the investment project.

First consider the case of the equity contract. The proportion of the external equity depends on the perceived value of the firm by the player I. Let  $F_0$  be player I's (investor's) perceived distribution function of player P's (project owner's) managerial ability,  $m_P$ . In equilibrium this perceived distribution should be the same as the actual distribution function  $F$ .

Since the investor is unaware of the managerial ability of the project owner, the value of the firm is perceived to be

$$y_0 = \int_0^1 Y(m) dF_0(m) \quad (1)$$

In order to raise the outside capital  $K$ , the firm sells the fraction  $K/y_0$  of its equity to the investor. Therefore, the expected payoff to the project owner is

$$R_E(m) = (1-K/y_0)y(m) \quad (2)$$

Now consider the case of the debt contract. Let  $B$  be the fixed promised payment of the debt. Given the rational expectations assumption, this amount is determined by

$$\int \left[ \int_0^B Y dG(Y|m) + \int_B^\infty B dG(Y|m) \right] dF_0(m) = K \quad (3)$$

The expected payoff to the project owner is thus

$$R_D(m) = \int_B^\infty (Y-B)dG(Y|m) \quad (4)$$

From (3) and (4),  $R_D(m)$  can be simplified to

$$R_D(m) = y(m) - K \quad (5)$$

Lemma 1: There exists  $m_0$  in  $(0,1)$  such that:

if  $m > m_0$ ,  $R_D(m) > R_E(m)$ ;

if  $m < m_0$ ,  $R_E(m) > R_D(m)$ .

proof: Define  $m_0$  to be the ability level such that

$$R_E(m_0) = R_D(m_0)$$

$$\text{Therefore } (1-K/y_0)y(m_0) = y(m_0) - K$$

$$\text{We have } y(m_0) = y_0 = \int Y(m)dF_0(m)$$

From the mean-value theorem of the integral,

$m_0$  exists.

For  $m > m_0$ ,  $y(m) > y(m_0)$  as  $G(Y|m)$  has the first order

stochastic dominance property.

$$\begin{aligned} \text{So } y(m)-K &> y(m) - [y(m)/y(m_0)]K \\ &= (1-K/y_0)y(m) \end{aligned}$$

We have  $R_D(m) > R_E(m)$ .

Similarly if  $m < m_0$ ,  $R_D(m) < R_E(m)$ . Q.E.D.

Lemma 1 is illustrated in Figure 1.

Figure 1 (Insert here)

From our analysis to this point, it seems that the project owners with managerial ability higher than  $m_0$  would prefer debt contracts for external financing, and those with lower levels of managerial ability would choose equity contract. However, given this separation of contract choice, the investors are able to infer some of the

unknown information about  $m_p$  from the contract choice. In equilibrium the investor would have a different perceived distribution function of  $m_p$  for player P depending on his contract choice.

Consider the case of equity financing. Let  $F_1$  be the investor's perceived distribution function of the project owner's ability given that the equity contract is used for the external financing. In equilibrium  $F_1$  should be the conditional distribution of  $m_p$  given that  $m_p$  is less than  $m_0$ .

Now given this new perceived distribution function  $F_1(m)=F_0(m|m < m_0)$ , the investor's perceived value of the firm would be

$$y_1 = \int Y(m)dF_1(m)$$

By the same analysis discussed above, it can be seen that there exists  $m_1$  in  $(0, m_0)$  such that firms with  $m > m_1$  now would choose debt contract instead of equity contract. Only those firms with  $m < m_1$  remain to use equity contracts. But again the perceived distribution of  $m_p$  of these firms would change due to this new separation of contract choice by the project owner.

This Akerloff (1970) style of argument goes on and on, resulting in the use of the debt contract by the firm. The distribution of  $m_p$  is correctly perceived to be  $F$  in equilibrium. The equity contract is a signal of poor managerial ability and would not be used. Therefore, we have the following proposition.

**Proposition 1:** In the model described above, the debt contract is used for external financing.

The model presented above does not justify the role of external equity in the firm's capital structure since no attempt is made to discuss the costs or disadvantages of debt usage or benefits from equity financing. As stated earlier, our purpose here is to explain the use of debt contracts in a simple but general world with asymmetric information. The model can contribute to our understanding



of high leverage in capital structure for closely held firms. The relationship between the equity and debt contracts is discussed in the next section.

#### IV. Self Selection by Equity and Debt Contracts

If the control of the firm is not necessarily granted to the project owner, it can be negotiated and specified in the contract. Assume that the player I's managerial ability is  $m_I$ ,  $m_I$  in  $[0,1]$ . We consider the case in which player I does not know the player P's managerial ability, but player P's ability is common knowledge. Player I may be a venture capitalist whose managerial skill is known from his past records while player P may be a private inventor or a know-how owner. If player I is in control, the resulting random cash flow  $Y$  is distributed as  $G(Y|m_I)$ .

A contract is defined as  $(s,v)$  where  $s=(s_I, s_P)$  specifies the sharing rule of the outcome for the two players and  $v=(v_I, v_P)$  designates the control right of each player. Then  $s$  and  $v$  satisfy:

$$\begin{aligned} s_I + s_P &= y, & s_I &\geq 0, s_P \geq 0; \\ v_I + v_P &= 1, & v_I, v_P &\text{in } \{0,1\}. \end{aligned}$$

The sharing rule and control right are considered separately so that we can discuss their relationship. One of the results in this section is that debt contract will be used with no control right assigned to the debtholder. Note that there is no proportionate voting scheme in this two-agent world since control itself has no value in our assumption. Any player is either in full control of the firm or has no control at all. A Pareto optimal outcome would be that the player with better managerial ability always gets control right.

Consider two sharing rules in which  $s_I$  is either a fixed amount of promised payment, which we denote as the debt sharing rule, or a fixed portion of the random payoffs, which we denote as the equity sharing rule. Suppose two contracts are designed in the following way:

$$\begin{aligned} \text{Contract D : } s_I(D) &= B, & s_P(D) &= y-B, \\ v_I(D) &= 0, & v_P(D) &= 1; \end{aligned}$$

$$\begin{aligned} \text{Contract E : } s_I(E) &= (1-c)y, & s_P(E) &= cy, \\ v_I(E) &= 1, & v_P(E) &= 0. \end{aligned}$$

where  $B$  and  $c$  are fixed numbers,  $0 < c < 1$ . To facilitate the self selection mechanism for optimal outcome, player  $P$  should choose contract  $D$  (to keep the control) if  $m_P > m_I$ , and choose contract  $E$  (so player  $I$  can have the control) if  $m_P < m_I$ . Therefore, the incentive compatible conditions are:

$$\begin{aligned} \text{If } m_P \geq m_I, & \quad s_P(D) \geq s_P(E); \\ \text{that is, } & \quad y(m_P) - B \text{ should be larger than } cy(m_I); \end{aligned}$$

$$\begin{aligned} \text{if } m_P < m_I, & \quad s_P(D) < s_P(E); \\ \text{that is, } & \quad cy(m_I) \text{ should be smaller than } y(m_P) - B. \end{aligned}$$

Lemma 2: The incentive compatible conditions described above are satisfied if  $B/(1-c) = y(m_I)$ .

proof: If  $B/(1-c) = y(m_I)$ , we have  $y(m_I) - B = cy(m_I)$ .

Then, if  $m_P \geq m_I$ ,  $y(m_P) - B \geq y(m_I) - B = cy(m_I)$ ;

and if  $m_P < m_I$ ,  $cy(m_I) = y(m_I) - B > y(m_P) - B$

Q.E.D.

Lemma 2 is illustrated in Figure 2.

Figure 2 (Insert here)

We notice that the player  $I$  is indifferent in contract  $D$  or con-

tract E given the conditions, i.e.,

$$\int_{m_I}^1 B dF(m_p) + \int_0^{m_I} (1-c)y(m_I) dF(m_p) = B = (1-c)y(m_I).$$

As always in a signalling model, there are infinite number of  $(B,c)$  pairs that can satisfy conditions in lemma 2. Our focus here is the equity and debt financing scheme discussed in section 3.

Proposition 2: The equity and debt financing scheme as described in section 3 constitutes a self selection mechanism if the debtholder requires no control right and the external equity holder is given the control right.

proof: From the discussion in section 3, with the modification of different control agent for each contract, we have  $B = K$ ,  $c = 1 - \{K/y(m_I)\}$ . So  $B/(1-c) = y(m_I)$ . Incentive conditions are satisfied. Q.E.D.

Therefore, some of the project owners use debt financing as part of a self selection mechanism and its sharing rule is associated with no control right for the debtholder. Other project owners use external equity financing and give the control right to the venture capitalist. Note that under this scheme, the firm is always controlled by the player with better managerial ability. If  $m_p > m_I$ , then the debt contract is used and player P controls the firm; if  $m_p < m_I$ , then the equity contract is used and player I controls the firm. As a result, the equity and debt contracts in proposition 2 do provide Pareto optimal outcome.

Proposition 3: The firm using the debt contract has a higher market value than the firm using the equity contract.

This result is consistent with the empirical studies in the literature (Masulis, 1983). Whenever an agent with a better managerial ability appears (who may be an outsider or the current control agent who has improved his ability through experience), he will exchange

debt contract for equity contract. The market value of the firm increases as the result of this exchange since it implies a better manager is in control.

One implication of proposition 3 is that an increase in leverage should be observed in merger and acquisition activities if the current control agent is replaced with a new control agent.

## V. Conclusions

Two issues about debt contracts are explored in this paper: why firms use debt if it is irrelevant, and why debtholders have no control right. A simple explanation is offered to study the reason of this widely observed arrangement. In the world of asymmetric information in which the investors do not know the managerial ability of the firm's owner, the use of debt financing is shown to be generally better than the use of external equity financing. We find that the debt contract either drives the external equity contract out of the market by revealing the bad managerial ability of the firm's owner, or is used in a self-selection scheme together with external equity contract. In this latter case, the debt contract is preferred by the firm's owner with better managerial ability, and the debtholder receives no control right of the firm. The implication of the model is consistent with the substantial use of debt in leveraged buyout or the merger and acquisition activities, and the resulting increase of the acquired firm's market value. It also contributes to our understanding of high leverage in capital structure for closely held firms.

The model makes no attempt to explain the coexistence of debt and external equity contracts since it is beyond the scope of this simple one-shot game without possible trading of the contracts. The

mixture of the external equity and debt contracts may be explored in a multi-period framework. Also, the bankruptcy situation is not considered here. These issues are left in the future studies.

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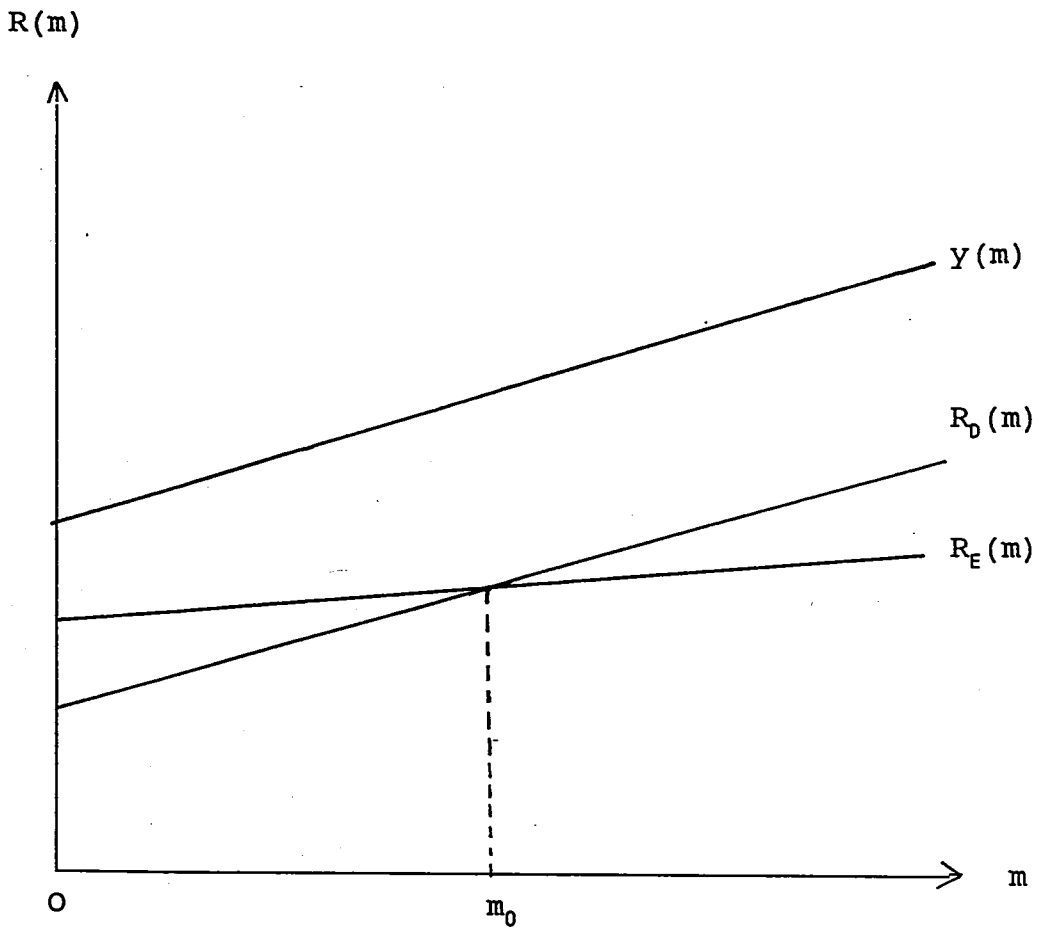


Figure 1

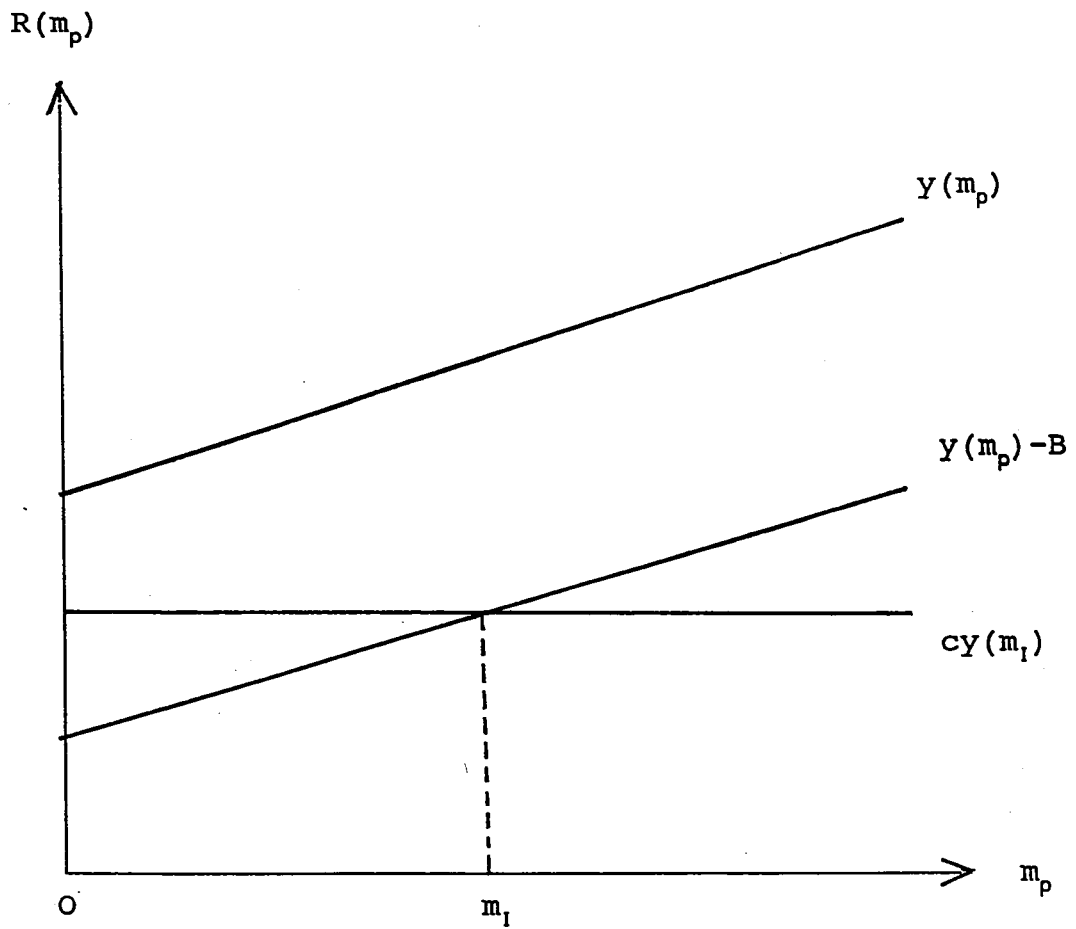


Figure 2

# 不對稱訊息與外部融資契約選擇

## ——企業舉債之研究

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### 摘要

本文之目的在探討兩項與債務契約有關的問題：沒有租稅津貼的情況下，企業為何舉債？債權人為何對企業經營沒有控制權？藉著不對稱訊息下的契約選擇理論，文中以簡單的模型解釋了這些普遍的現象。企業如需對外籌資以營運，而投資人不了解企業主之管理能力，本文證明了舉債優於發行股票。若企業主欲保持經營控制權，發行股票將顯示出自己管理能力較差，為免投資人不願投資，惟有舉債。如果經營控制權可以商議，則債卷與股票將共同存在於市場中。此時管理能力較強的企業主將發行債卷，但自行保持經營控制權；管理能力差的，將發行股票並讓出經營權，但可享有較佳的報酬。從模型中可引申如下推論：股權較集中的企業通常有較高的負債比例；而企業合併若有經營者更換的現象，亦將提高負債比例。這些推論與一些實證研究結果，頗相符合。

**關鍵詞：**債務契約，契約選擇，經營控制權，外部融資，不對稱訊息