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## Investment policy with heterogeneous beliefs of investors

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### Abstract

The theoretical work on the dividend policy of a firm suggests five imperfections that management should consider. Different from these five frameworks, our theoretical work develops a model regarding an optimal investment–dividend policy to maximize a firm’s value with divergent types of shareholders. The results show that an optimal dividend policy does exist under a heterogeneous beliefs framework.

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### 1. Introduction

Investment–dividend policy is one of the most important courses of action concerned with in a firm’s corporate finance. Classic literature assumes that investors have the same beliefs given the same information. However, the common beliefs assumption is suitable for traditional and mature industries, because available information is rich and a large amount of experience has been accumulated. Conversely, in this paper the common beliefs assumption is not allowed even when given the same information because people agree to disagree due to facing a completely new industry, i.e., biotechnology.

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Allen and Gale (1999) argued that a common prior assumption is not appropriate when considering new industries such as biotechnology and new technologies such as personal computers. Investors agree to disagree, because the amount of data available based on actual experience with a new product is non-existent or small. In our model, heterogeneous beliefs of investors are directly given. A simple, clear, and general investment function is utilized to directly express a real estimation on the future earnings of a firm. This function helps us to explore heterogeneity deeper and more. Concrete results are therefore obtained.

Miller and Rock (1985) and John and Williams (1985) proposed that firms adjust dividends to signal their prospects. A rise in dividend typically signals that the firm will do better, and a decrease suggests that it will do worse. In the research herein, however, dividend policy is not determined by a firm's character, but rather from investors' viewpoints. As the beliefs of investors are not homogeneous, a firm's optimal investment–dividend policy is affected. A high dividend policy is appropriate as the beliefs among investors are heterogeneous. We interpret this novel result not based on the traditional signaling theories, but on heterogeneity.

## 2. The model

We consider an economy where there are no transaction costs or taxes. A firm is initially owned by an entrepreneur, who wants to find the value-maximizing investment expenditure  $I$  and cash dividend  $D$  before selling his shares to public investors and leaving the market. At  $t=0$ , the firm is endowed with cash earnings  $X>0$  and investment function  $F(I)=a^i[\ln(I+b)]$ . There are two groups of investors, called optimists,  $i=o$ , and pessimists,  $i=p$ , agreeing to disagree about the parameter  $a^i$ .

Relaxing the common beliefs assumption, divergent investors receive common information, but differ in the way in which they interpret this information. We assume that there are two types of investors, optimistic and pessimistic ones. The investment function is described by the following equation:

$$F(I) = a^i[\ln(I + b)]; \quad i \in o, p. \quad (1)$$

The optimists believe that  $a=a^o$  and the pessimists believe that  $a=a^p$ , where  $a^o > a^p \geq 1$ . The total wealth of the optimists is  $W>0$ .

The entrepreneur decides on the optimal dividend policy  $D$  and invests  $I$  coming from his endowment  $X$  in a production process whose output at the end of the period is  $F(I)=a^i[\ln(I+b)]$ . Hence, the firm's value can be expressed as

$$V = D + F(I) = X - I + a^i[\ln(I + b)]. \quad (2)$$

An entrepreneur can sell the shares only to the optimists, or he can sell some shares to the pessimists upon seeing the valuation by different types of investors and the wealth of the optimists. If the type- $o$  investors have no wealth limit, then the entrepreneur will implement the first alternative. In contrast, the entrepreneur will choose to implement the second alternative. The key point is the divergent types of investors.

The wealth of optimistic investors  $W$  is generally limited so that they do not have enough money to buy all the shares, and at least one pessimistic investor will buy some shares. The entrepreneur must consider selling the shares to both optimistic and pessimistic investors.

3. Results

**Theorem 1.** A high dividend policy is optimal with a limited endowment for the optimistic investors as the stocks are sold not only to type-o investors, but also to at least one type-p investor holding some shares.

**Proof.** The entrepreneur wants to maximize his profit by pricing the stock at the highest valuation estimated by different types of investors. However, the optimistic investors do not have enough money due to the wealth constraint assumed previously. If the entrepreneur still prices the stock at  $P=X-I+a^0\ln(I+b)$ , then there will be no one to buy the stock. Hence, the entrepreneur has to lower down the price to

$$P = X - I + a^p\ln(I + b). \tag{3}$$

Assume that the wealth of optimistic investors  $W$  is less than the valuation for the firm by them. In equilibrium, both type-o and type-p investors will hold some shares. The first-order condition requires

$$\frac{\partial P}{\partial I} = 0 = -1 + \frac{a^p}{I + b}. \tag{4}$$

The equilibrium price is

$$P^* = X - a^p + b + a^p\ln(a^p). \tag{5}$$

The optimal dividend policy is then derived as

$$D^* = X - a^p + b. \tag{6}$$

Based on the assumption,

$$a^p < a < a^0$$

we can derive

$$D^* = X - a^p + b > X - a + b > X - a^0 + b. \tag{7}$$

Consequently, a high dividend policy is appropriate as the stocks are sold not only to type-o investors, but also to at least one type-p investor holding some shares. This completes the proof.

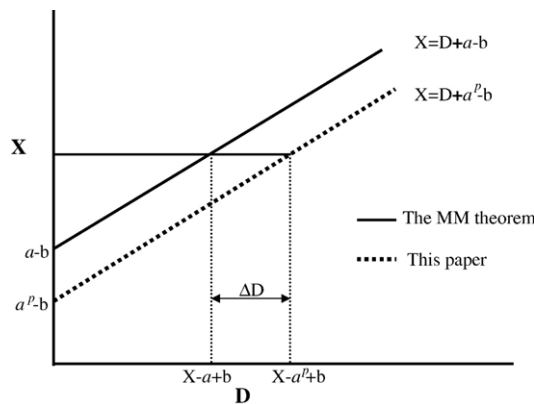


Fig. 1. The difference in cash dividend paid between MM and this paper.

As shown in Fig. 1, the solution is away from that of the MM dividend invariance theorem due to heterogeneous beliefs on investors and the wealth constraint. In this case, the investment expenditure is shaved from  $(a-b)$  to  $(a^p-b)$ . This will result in changing the investment and dividend policy. For a given  $X$  in Fig. 1, the dividend is hence increased from  $(X-a+b)$  to  $(X-a^p+b)$ . The cash dividend paid in difference between the MM theorem and this case is  $\Delta D = a - a^p$ . The result is different from that of the MM dividend invariance theorem.

For a special case, i.e., there is no limited wealth for the optimistic investors, the entrepreneur should choose another investment–dividend policy. The following lemma presents the different result compared to that of the general condition.  $\square$

**Lemma 1.** *A low dividend policy is appropriate when cash dividend  $D = X - a^o + b$  is optimal as the shares are sold only to type-o investors.*

**Proof.** The optimists' valuations for the firm are described as

$$V^o = X - I + a^o \ln(I + b). \quad (8)$$

In contrast, the pessimists' valuations for the firm are

$$V^p = X - I + a^p \ln(I + b). \quad (9)$$

Due to the optimistic investors being without a limited endowment, all of the shares will be sold to the optimistic investors. The price of the stock is

$$P = X - I + a^o \ln(I + b). \quad (10)$$

The first-order condition of Eq. (10) requires

$$\frac{\partial P}{\partial I} = 0 = -1 + \frac{a^o}{I + b}. \quad (11)$$

We arrive at the equilibrium price

$$P^* = X - a^o + b + a^o \ln(a^o). \quad (12)$$

Optimal dividend policy is then derived as

$$D^* = X - a^o + b. \quad (13)$$

Therefore, a low dividend policy is appropriate when cash dividend  $D = X - a^o + b$  is optimal as the shares are sold only to type-o investors. This completes the proof.  $\square$

#### 4. Conclusion

This paper has analyzed heterogeneous beliefs among investors that lead to a change in a firm's optimal investment–dividend policy. A firm's optimal policy is different from that of the MM theorem. It is not due to taxes, asymmetric information, incomplete contracts, institutional constraints, and/or transaction costs, but rather to the heterogeneous beliefs of investors.

A high dividend policy is optimal under a limited endowment for the optimistic investors as the stocks are sold not only to type-o investors, but also to at least one type-p investor holding some shares. The heterogeneous beliefs of investors change the investment–dividend policy given the same information even under full information. We have herein successfully relaxed one of the most important assumptions—homogeneous beliefs among investors.

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