Payout Policy and Real Investment under Asymmetric Information

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Abstract

This paper develops a theoretical model explaining management's choice of using corporate cash flow to pay dividends, repurchase shares, or invest in a real project.The model demonstrates the case in which managers have better information than investors about the quality of the firm (information asymmetry) and may invest excess cash in unprofitable projects rather than return it to shareholders (moral hazard). The results show that paying dividends is a dominated strategy for the high-quality firm.In an efficient market, there exists a separating equilibrium in which the high-quality firm invests in the new project while the low-quality firm pays dividends. However, ifinvestors underreact to share repurchase announcements, there exists a separating equilibrium in which the high-quality firm repurchases shares while the low-quality firm pays dividends.

Keywords: Asymmetric Information, Signaling, Payout, Dividends, Share repurchases, Underreaction

1. Introduction

Over recent decades, share repurchases has become a primary means of returning company's cash flows to shareholders. Grullon and Michaely (2002) documented that while share repurchase expenditures in the U.S. grew at an average annual rate of 26.1% over the period 1980 to 2000, dividends grew only at an average annual rate of 6.8%. In fact, in 1998, industrial firms spent more money on share repurchases ($181.8 billion) than on cash dividends ($174.1 billion). In general, the market has applauded the share repurchase programs. Prior research has documented an average abnormal return of approximately 3% on open market share repurchase announcements (e.g., Vermaelen (1981), Comment and Jarrell (1991), Ikenberry, Lakonishok, and Vermalen (1995), Stephens and Weisbach (1998), and Grullon and Michaely (2002).

One of the most cited explanations for this positive announcement return is the signaling hypothesis, which suggests that the managers use payoutsto convey favorable information about the firm's prospect to outside shareholders.Traditional dividend signalingmodels show that dividends convey favorable information about future profitability (e.g., Bhattachaya (1979), Miller and Rock (1985), John and Williams (1985), and Ambarish et al. (1987)).These models suggest that managers who foresee better performance can send positive signal to investors by paying out dividends today because they are confident that future capital requirements can be financed by future earnings. On the other hand, managers who do not expect any improvement in profitability are refrained from doing so because they might have to forego profitable investments or raise costly external funds in the future. According to Modigliani and Miller (1961), the value of the firm in a perfect market is independent of the payout policy, implying that dividends and share repurchases are perfect substitutes. Since the market is imperfect, however, the managers' choices between paying dividends and repurchasing shares affect firm value differently. At least with respect to the tax efficiency, firms should repurchase shares rather than pay dividends because share repurchases, generally treated by tax authorities as capital gains, are taxed at a lower rate than dividends. However, firms still pay a large portion of their earnings as cash dividends despite its tax disadvantage relative to share repurchases, and this is known as 'dividend puzzle' in finance literature (Black, 1976).

Several researchers attempt to explain this puzzle from theoretical perspective. For example, Ofer and Thakor (1987) develop a signaling model in which managers can signal their firm values by using either a dividend or a (tender offer) share repurchaseor both.Their model shows that, when the difference between the true value of an undervalued firm and its market value is relatively low, the firm chooses to signal by dividends because of a relatively lowersignaling cost than that of a share repurchase. However, when the true firm value is much higher than its market value, the firm chooses to signal by share repurchases because a relatively large dividend is needed for informationally consistent signaling. In an adverse selection model, Brennan and Thakor (1990) explain why share repurchases are disadvantageous compared to dividends. Their model demonstrates that when firms repurchase shares, some shareholders are better informed about the firm's prospects than others and able to take advantage of this information asymmetry but, when firms pay dividends, both informed and uninformed investors receive a pro rata amount. As a result, uninformed investors prefer dividends to share repurchases.

Hausch and Seward (1993) develop a model in which the firm's choice of signaling with share repurchasesor cash dividends depends on the level of internally-generated cash flowsavailable for investment. Since the high-quality firm has less absolute risk aversion and more cash available for investmentthan the low-quality firm, the high-quality firm can more efficiently distinguish itself from the low-quality firm using a share repurchase.On the contrary, Chowdhry and Nanda (1994) argue that it is the fact that tender offerrepurchases are associated with large stock price increases that makes them unattractive means of distributing cash. The occasions when share repurchases would not be costly to the firm, despite the large premium it must pay to acquire its own shares, are when the firm's stock is deeply undervalued by the market compared to its true value observed by managers.However, Persons (1997) argue that tender offer repurchases have advantages over other possible signals like dividends and firms overpay for tender offer repurchases because of heterogeneous shareholders' stock price valuation.A small increase in tender offer shares repurchased is more costly for a low-value firm to imitate than a small increase in dividends. Therefore, dividends are used to signal small differences in value while repurchases are used to signal large differences in stock price valuation.

Most of the previous modelsfocus on the share repurchase tender offers, which are now relatively less common compared to open-market share repurchases, and consider only twochoices of payouts (i.e.,dividends or stock repurchases) while, in practice, the manager may use the firm's cash flow to invest in unprofitable projects in order to consume private benefits. Considering this alternative, Isagawa (2000) develops a signaling model in which the manager choosesbetween open-market share repurchases and a real investment in a new project from which the manager receives private benefits, and derives a separating equilibrium in which a manager with high private benefits chooses to invest in a new project while a manager with low private benefits chooses to repurchase shares. His model provides a key insight regarding the effect of private benefits on manager's repurchasingdecision. Nevertheless, his model appears to be incomplete in that: (1) it does not include a cash dividend, which is a primary means of corporate payouts; (2) it considers only the case where the managerial compensation is tied only to the firm's long-term value; and (3) it does not consider anincrease in managerial equity stake after shares are repurchased.

Hence, this paper contributes to Isagawa's (2000) analysis in the following ways. First, it develops a more completesignaling model in which the managers of a high-quality firm and alow-quality firm decide to use the firm's cash flow to invest in a new project, pay cash dividends, or repurchase shares via open market. Second, it considers the case where the managerial compensation is tied to both the short-term market value of the firm immediately after the manager announces his investment/payout policy, and the fundamental value of the firm after the return from investment is realized or the cash flow is returned to investors in the form of dividends or share repurchases. This provides additional insights into managerial myopia/farsightedness. Third, it considers anincrease in managerial equity stake in the firm after shares are repurchased. Further, it considers the case where investors underreact to open market share repurchase announcements(Note 1).The rest of this paper is organized as follows. Section 2 outlines the signaling model of manager'spayout/investment decisions. Section 3analyzes the equilibrium outcomes.Section 4 concludes the paper.

2. The Model

Consider a market consisting of two all-equity firms whose type $i \in \{H, L\}$, where H represents a high-quality type and L represents a low-quality type. A high-quality firm is characterized by better future prospects than a low quality firm (to be examined in more detail below). At date 0, each firm has N shares outstanding, of which the manager has N_M shares, and the outsiders have N_S shares. Hence, $N = N_M + N_S$. In addition, each firm i has assets in place of Y_i, with $Y_H > Y_L$, which will generate a date 1cash flow $X > 0$. The market cannot observe firm type, so it assigns an equal probability to each firm being type H or L.At date 1, the management of each firm simultaneously decides between three possible uses of cashflow X. Firstly, each firm can invest the cashflow in a new project. This provides an income at date 2 of $X(1+r_i)$, where $r_H > 0$ and $r_L < 0$ (i.e., type Hfirm has a positive NPV project available, while type L firm has a negative NPV project available). Further, it takes as given that $r_H + r_L = 0$; that is, the positive and negative NPV projects exactly balance each other, and, on average, the projects have zero NPV. (This assumption greatly simplifies the analysis without changing the intuition of the model).Secondly,each type can use the cashflow to invest at zero NPV in the financial market, using the proceeds to pay a dividend X at date 2. Thirdly, each firm can use the cashflow to repurchase some shares. The managers' date 1 policy decisions may provide information to the market regarding firm type.At date 2, typesare revealed and payouts occur.

This model is a signaling game in which I solve for the Bayesian equilibria. Hence, the manager's objective function and the market's posterior beliefs upon observing the managers' date 1 decision must be specified. The manager has an equity stake in the firm that does not change under a policy of investing in the new project or paying dividends, but does change if the manager repurchases and destroys shares. The manager's date 0 equity stake is represented as $\alpha = \frac{N_M}{N}$. Under the dividend or investment policy,his equity stake remains α throughout 2 dates. I also define a post-repurchase managerial equity stake as β. Since repurchasing increases the managerial equity stake, $\beta > \alpha$.

The managerial payoff function is defined as

$$\Pi_M = \alpha w_1 \hat{V}_1 + \beta w_2 V_2 \tag{1}$$

where α represents the managers' (exogenously given) equity stake in the firm, $\hat{V}_1$ represents the date 1 market value of the firm (which is determined by the date 1 signal), and V_2 represents the date 2 fundamental value of the firm. Further, w_1 represents the weight that the manager assigns to the date 1 value of the firm, and w_2 represents the weight that the manager assigns to the date 2 value of the firm. If manager i decides to use cashflow X to repurchase shares (with the repurchased shares being destroyed), he increases his equity stake to β.

Next, the market's posterior beliefs are specified. Firstly, note that if both firms undertake identical policies, the market is unable to update its beliefs; it continues to assign an equal probability to each firm being high or low-quality. If the firms separate, the market's beliefs when it observes signals $\{s_H, s_L\}$ are specified as follows: if the market observes $\{R, D\}$, it believes that the firms are $\{H, L\}$ respectively;if the market observes $\{R, I\}$, it believes that the firms are $\{H, L\}$ respectively; and if the market observes $\{I, D\}$, it believes that the firms are $\{H, L\}$ respectively. In Bayesian equilibrium, the firms' equilibrium strategies are consistent with these beliefs.

Lemma 1 The effects of the firms' repurchasing policy on the manager's expected compensationare as follows:

Pooling: If both firms repurchase at date 1, manager H's and manager L's expected compensations are

$$\Pi_{MH}\{R, R\} = \alpha\left[w_1\left(\frac{Y_H + Y_L + 2X}{2}\right) + w_2\left(\frac{Y_H + Y_L + 2X}{Y_H + Y_L}\right)Y_H\right] \tag{2}$$

$$\Pi_{ML}\{R, R\} = \alpha\left[w_1\left(\frac{Y_H + Y_L + 2X}{2}\right) + w_2\left(\frac{Y_H + Y_L + 2X}{Y_H + Y_L}\right)Y_L\right] \tag{3}$$

b) Separation consistent with market beliefs: If the firms separate with only firm H repurchasing shares, manager H's expected compensations are

$$\Pi_{MH}\{R, I\} = \alpha\left[w_1(Y_H + X) + w_2(Y_H + X)\right] \tag{4}$$

$$\Pi_{MH}\{R, D\} = \alpha\left[w_1(Y_H + X) + w_2(Y_H + X)\right] \tag{5}$$

c) Separation inconsistent with market beliefs: If the firms separate with only firm L repurchasing shares, manager L's expected compensation are

$$\Pi_{ML}\{I, R\} = \alpha\left[w_1(Y_H + X) + w_2\left(\frac{Y_H + X}{Y_H}\right)Y_L\right] \tag{6}$$

$$\Pi_{ML}\{D, R\} = \alpha\left[w_1(Y_H + X) + w_2\left(\frac{Y_H + X}{Y_H}\right)Y_L\right] \tag{7}$$

Proof: See Appendix.

Lemma 2 The effects of the firms' dividend policy on the manager's expected compensation are as follows:

If both firms pay dividends, then

$$\Pi_{MH}\{D, D\} = \alpha\left[w_1\left(\frac{Y_H + Y_L + 2X}{2}\right) + w_2(Y_H + X)\right] \tag{8}$$

$$\Pi_{ML}\{D,D\} = \alpha\left[w_1\left(\frac{Y_H + Y_L + 2X}{2} \right) + w_2\left(Y_L + X \right) \right] \tag{9}$$

b) If the high-quality firm repurchases shares, and the low-quality firm pays dividends, then, given the beliefs, the payoff for the low quality manager is

$$\Pi_{ML}\{R,D\} = \alpha\left[w_1\left(Y_L + X \right) + w_2\left(Y_L + X \right) \right] \tag{10}$$

c) If the low-quality firm repurchases shares, and the high-quality firm pays dividends, then, given the beliefs, the payoff for the high quality manager is

$$\Pi_{MH}\{D,R\} = \alpha\left[w_1\left(Y_L + X \right) + w_2\left(Y_H + X \right) \right] \tag{11}$$

Proof: See Appendix.

Lemma 3 The effects of the firms' project-investment policy on the manager's expected compensation are as follows:

a)If both firms invest in the new project,then

$$\Pi_{MH}\{I,I\} = \alpha\left[\left(w_1\left(\frac{Y_H + Y_L}{2} \right) + X \right) + w_2\left(Y_H + X\left(1 + r_H \right) \right) \right] \tag{12}$$

$$\Pi_{ML}\{I,I\} = \alpha\left[\left(w_1\left(\frac{Y_H + Y_L}{2} \right) + X \right) + w_2\left(Y_L + X\left(1 + r_L \right) \right) \right] \tag{13}$$

b) If the high-quality firm repurchases, and the low-quality firm invests in the new project, then, given the beliefs, the payoff for the low quality manager is

$$\Pi_{ML}\{R,I\} = \alpha\left[w_1\left(Y_L + X\left(1 + r_L \right) \right) + w_2\left(Y_L + X\left(1 + r_L \right) \right) \right] \tag{14}$$

c) If the low-quality firm repurchases, and the high-quality firm invests in the new project, then, given the beliefs, the payoff for the high quality manager is

$$\Pi_{MH}\{I,R\} = \alpha\left[w_1\left(Y_L + X\left(1 + r_L \right) \right) + w_2\left(Y_H + X\left(1 + r_H \right) \right) \right] \tag{15}$$

d) If the high-quality firm invests in the new project, and the low-quality firm pays dividends, then, given the beliefs, the payoffs are

$$\Pi_{MH}\{I,D\} = \alpha\left[w_1\left(Y_H + X\left(1 + r_H \right) \right) + w_2\left(Y_H + X\left(1 + r_H \right) \right) \right] \tag{16}$$

$$\Pi_{ML}\{I,D\} = \alpha\left[w_1\left(Y_L + X \right) + w_2\left(Y_L + X \right) \right] \tag{17}$$

e) If the low-quality firm invests in the new project, and the high-quality firm pays dividends, then, given the beliefs, the payoffs are

$$\Pi_{MH}\{D,I\} = \alpha\left[w_1\left(Y_L + X \right) + w_2\left(Y_H + X \right) \right] \tag{18}$$

$$\Pi_{ML}\{D,I\} = \alpha\left[w_1\left(Y_H + X\left(1 + r_H \right) \right) + w_2\left(Y_L + X\left(1 + r_L \right) \right) \right] \tag{19}$$

Proof: See Appendix.

3. Equilibrium Analysis

3.1 The case of efficient signaling

Using the payoffs given in lemma 1, 2, and3, the equilibrium of the game can be derived. Ifirst consider each firm's best responses when $w_1 = w_2 = 1/2$.

Lemma 4 Payingdividends is a dominated strategy for firm H. Its best responses are

If firm L chooses to invest in the new project, firm H's best response is to invest in the new project if $Xr_H \geq \frac{Y_H - Y_L}{2}$, but to repurchase shares if $Xr_H < \frac{Y_H - Y_L}{2}$.

If firm L chooses to pay dividends, firm H's best response is to invest in the new project.

If firm L chooses to repurchase shares, firm H's best response is also to repurchase shares.

Proof: See Appendix.

Lemma 5Firm L's best responses are

If firm H chooses to invest in the new project, firm L's best response is to invest in the new projectif $Xr_L \geq \frac{Y_L - Y_H}{2}$ and $X\left(1 + r_L - \frac{Y_L}{Y_H}\right) \geq \frac{Y_H - Y_L}{2}$,topay dividends if $Xr_L < \frac{Y_L - Y_H}{2}$ and $X \geq Y_H$, or to repurchase shares if $X\left(1 + r_L - \frac{Y_L}{Y_H}\right) < \frac{Y_H - Y_L}{2}$ and $X < Y_H$.

If firm H chooses to repurchase shares, firm L's best response is also to repurchase shares if $X < \frac{Y_H + Y_L}{2}$, but to pay dividends if $X \geq \frac{Y_H + Y_L}{2}$.

Proof: See Appendix.

Note that I do not need to consider firm *L*'s best response to firm *H* paying dividends, sincepaying dividends is a dominated strategy for firm *H*.To make analysis tractable, it isassumed that (Note 2)

$$Xr_H \geq \frac{Y_H - Y_L}{2} \quad \text{(a1)}$$

$$X\left(1 + r_L - \frac{Y_L}{Y_H}\right) \geq \frac{Y_H - Y_L}{2} \quad \text{(a2)}$$

Proposition 1 From lemma 4, lemma 5,assumption (a1), and assumption (a2), the following equilibria are derived:

If $Xr_L \geq \frac{Y_L - Y_H}{2}$ and $X \geq Y_H$, theunique equilibriumis $\{I, I\}$.

If $Xr_L \geq \frac{Y_L - Y_H}{2}$ and $\frac{Y_H + Y_L}{2} \leq X < Y_H$, the unique equilibrium is $\{I, I\}$.

If $Xr_L \geq \frac{Y_L - Y_H}{2}$ and $X < \frac{Y_H + Y_L}{2}$, the multiple equilibria are $\{I, I\}$ and $\{R, R\}$.

If $Xr_L < \frac{Y_L - Y_H}{2}$ and $X \geq Y_H$, the unique equilibrium is $\{I, D\}$.

If $Xr_L < \frac{Y_L - Y_H}{2}$ and $\frac{Y_H + Y_L}{2} \leq X < Y_H$, there is no equilibrium.

If $Xr_L < \frac{Y_L - Y_H}{2}$ and $X < \frac{Y_H + Y_L}{2}$, the unique equilibrium is $\{R, R\}$.

Corollary1 If the manager is completely myopic $(w_1 = 1, w_2 = 0)$, repurchasing shares is a dominant strategy for firm L and there exists a pooling equilibrium in which both firms repurchase shares $\{R, R\}$.

Proof: Substituting $w_1 = 1, w_2 = 0$ intoequations (2) to (19) and solving for equilibrium, a pooling equilibrium $\{R, R\}$ is obtained since (2) > (15), and (3) > (10) > (14).■

Corollary 2If the manager is completely farsighted $(w_1 = 0, w_2 = 1)$, paying dividends is a dominant strategy for firm L and there exists a separating equilibrium in which firm H invests in the new project while firm L pays dividends $\{I, D\}$.

Proof: Substituting $w_1 = 0, w_2 = 1$ intoequations (2) – (19) and solving for equilibrium, a separating equilibrium $\{I, D\}$ is obtained since (16) > (5), (17) > (6), and (17) > (13).■

3.2The case ofmarket underreaction to share repurchases

In this further analysis, firm *H*'s manager attempts to signal that his firm is undervalued by announcing a share repurchase program. However, investors underreact to the share repurchase announcements. That is, they fail to recognize that managersrepurchase shares in order to time the market (See, e.g., Ikenberry et al. (1995), Brockman and Chung (2001), Zhang (2005), and Chan et al. (2007)). In particular, the investors do not update their belief when they observe the signal $\{D,R\}$ or $\{R,D\}$, but continue to assign equal probability to both firm types. The amended managerial payoffs for such strategy combinations are

$$M_H\{D,R\} = \alpha\left[w_1\left(\frac{Y_H+Y_L+2X}{2}\right)+w_2\left(Y_H+X\right)\right] \tag{20}$$

$$M_L\{D,R\} = \alpha\left[w_1\left(\frac{Y_H+Y_L+2X}{2}\right)+w_2\left(\frac{Y_H+Y_L+2X}{Y_H+Y_L}\right)Y_L\right] \tag{21}$$

$$M_H\{R,D\} = \alpha\left[w_1\left(\frac{Y_H+Y_L+2X}{2}\right)+w_2\left(\frac{Y_H+Y_L+2X}{Y_H+Y_L}\right)Y_H\right] \tag{22}$$

$$M_L\{R,D\} = \alpha\left[w_1\left(\frac{Y_H+Y_L+2X}{2}\right)+w_2\left(Y_L+X\right)\right] \tag{23}$$

Re-analyzing the managerial payoffs, I derive the following results.

Lemma 6 Paying dividends is a dominated strategy for firm H. Firm H's best responses are as follows:

If firm L chooses to invest in the new project, firm H's best response is to invest in the new project if $Xr_H \geq \frac{Y_H-Y_L}{2}$. If $Xr_H < \frac{Y_H-Y_L}{2}$, firm H's best response is to repurchase shares.

If firm L chooses to pay dividends, firm H's best response is to invest in the new project if $Xr_H \geq X\left(\frac{Y_H-Y_L}{Y_H+Y_L}\right)-\left(\frac{Y_H-Y_L}{2}\right)$ but to repurchase shares if $Xr_H < X\left(\frac{Y_H-Y_L}{Y_H+Y_L}\right)-\left(\frac{Y_H-Y_L}{2}\right)$.

If firm L chooses to repurchase shares, firm H's best response is also to repurchase shares.

Proof: See Appendix.

Lemma 7 Firm L's best responses are as follows:

If firm H chooses to invest in the new project, firm L's best response is to invest in the new project if $Xr_L \geq \frac{Y_L-Y_H}{2}$ and $X\left(1+r_L-\frac{Y_L}{Y_H}\right) \geq \frac{Y_H-Y_L}{2}$, to pay dividends if $Xr_L < \frac{Y_L-Y_H}{2}$ and $X \geq Y_H$, or to repurchase shares if $X\left(1+r_L-\frac{Y_L}{Y_H}\right) < \frac{Y_H-Y_L}{2}$ and $X < Y_H$.

If firm H chooses to repurchase shares, firm L's best response is to pay dividends.

Proof: See Appendix.

To make analysis tractable, a further condition is introduced(Note 3)

$$X \geq Y_H \tag{c1}$$

Proposition 2From lemma 6, lemma 7, assumption (a1), and assumption (a2),I derive the following equilibria:

If $Xr_L \geq \frac{Y_L-Y_H}{2}$ and $Xr_H \geq X\left(\frac{Y_H-Y_L}{Y_H+Y_L}\right)-\left(\frac{Y_H-Y_L}{2}\right)$, the unique equilibrium is $\{I,I\}$ regardless of whether (c1) holds.

If $Xr_L \geq \frac{Y_L-Y_H}{2}$ and $Xr_H < X\left(\frac{Y_H-Y_L}{Y_H+Y_L}\right)-\left(\frac{Y_H-Y_L}{2}\right)$, the multiple equilibria are $\{I,I\}$ and $\{R,D\}$ regardless of whether (c1) holds.

If $Xr_L < \frac{Y_L - Y_H}{2}$, $Xr_H \geq X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) - \left(\frac{Y_H - Y_L}{2}\right)$, and(c1) holds, the unique equilibrium is $\{I, D\}$.

If $Xr_L < \frac{Y_L - Y_H}{2}$, $Xr_H \geq X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) - \left(\frac{Y_H - Y_L}{2}\right)$, and (c1) is violated, there is no equilibrium.

If $Xr_L < \frac{Y_L - Y_H}{2}$ and $Xr_H < X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) - \left(\frac{Y_H - Y_L}{2}\right)$, the unique equilibrium is $\{R, D\}$ regardless of whether (c1) holds.

4. Conclusion

I develop a signaling model that simultaneously considers the managers' payout/investment decisions. In the model, the manager's compensation is tied to both the short-term value of the firm so that the managerial myopia/farsightedness can be analyzed. The model shows that paying dividends is a dominated strategy for high-quality firm. If the managers place equal weights to short-term and long-term payoffs, there exists a separating equilibrium in which thehigh-quality firm invests in the new project while the low-quality firm pays dividends.If the managers are completely myopic, there is a pooling equilibrium in which both firms repurchase shares. In this case, thelow-quality firm sends false signal to the market to maximize its short-term stock price at the expenses of long-term shareholders.On the other hand, if the managers are completely farsighted, there is a separating equilibrium in which thehigh-quality firm invests in the new project while thelow-quality firm pays dividends.In this case, paying dividends is a dominant strategy for the low-quality firmsince the manager's objective is tocreate values for long-term shareholders.

In a further analysis of market underreaction to share repurchases, a separating equilibrium in which the high-quality firm repurchases shares while thelow-quality firm pays dividends is obtained. This result supports the notion that a major reason for share repurchases is to signal undervaluation.Overall, this paperemphasizes the role of open-market share repurchases as signals for firm undervaluation. The future research could analyze the effects of private benefits on equilibrium outcomes or develop a more integrated model that also considers the role of dividends asa mitigation of agency cost of free cash flows.

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Notes

Note 1. If the market reacts immediately and fully to share repurchase announcements, it will be futile for firms to subsequently acquire shares since there is no capital gain from doing so. For example, Ikenberry et al. (1995) find that the average abnormal four-year buy-and-hold return measured after the initial announcements is 12.1%, suggesting that the market underreacts to open market share repurchase announcements.

Note 2. Without assumptions (a1) and (a2), the number of permutations of conditions is significantly increased, making the analysis more complex.

Note 3. This condition represents the case where firms have substantial free cash flows.

Appendix

Proof of Lemma 1

a) If both firms repurchase at date 1, the manager's payoff is derived as follows. Initially, the manager has N_M shares, and the outsiders have N_S shares. Therefore, the total number of shares is $N = N_M + N_S$ and $\alpha = \frac{N_M}{N}$. At date 0, prior to the policy announcement, the value of the firm and price per share are $\overline{V}_0 = \frac{Y_H + Y_L + 2X}{2}$, $\overline{P}_0 = \frac{Y_H + Y_L + 2X}{2N}$.

At date 1, the manager repurchases $X = \theta \hat{V}_1$. Since both firms repurchase shares, the type is not revealed at date 1. Hence, $\hat{V}_1 = \overline{V}_0$, and $\hat{P}_1 = \overline{P}_0$. Therefore, the proportion of repurchased shares is $\theta = \frac{X}{\hat{V}_1} = \frac{2X}{Y_H + Y_L + 2X}$. Thus, the number of shares repurchased (and destroyed) is $N_R = \frac{X}{\hat{P}_1} = \frac{2XN}{Y_H + Y_L + 2X}$. The new total number of shares is $N - N_R = \frac{(Y_H + Y_L)N}{Y_H + Y_L + 2X}$. The manager still holds N_M. Therefore, the manager's post-repurchase equity stake is $\beta = \frac{N_M}{N - N_R} = \frac{N_M(Y_H + Y_L + 2X)}{N(Y_H + Y_L)} = \frac{Y_H + Y_L + 2X}{Y_H + Y_L}\alpha$. Substituting $\hat{V}_1, V_2, and \beta$ into (1), I obtain the payoffs in lemma 1a).

b) If only firm H repurchases (so that the market is consistent in its beliefs), $\hat{V}_{1H}(R) = Y_H + X$, and $\hat{P}_{1H}(R) = \frac{Y_H + X}{N}$. Hence, the proportion repurchased is $\theta = \frac{X}{\hat{V}_1} = \frac{X}{Y_H + X}$. Thus, the number of shares repurchased (and destroyed) is $N_R = \frac{X}{\hat{P}_1} = \frac{XN}{Y_H + X}$. As a result, the new total number of shares is $N - N_R = \frac{Y_H N}{Y_H + X}$. The manager still holds N_M. Therefore, the manager's post-repurchase equity stake is $\beta = \frac{N_M}{N - N_R} = \frac{N_M(Y_H + X)}{NY_H} = \frac{Y_H + X}{Y_H}\alpha$. Substituting $\hat{V}_1, V_2, and \beta$ into (1), I obtain firm H's payoff given in lemma 1b).

If only firm L repurchases (so that the market is incorrect in its beliefs, i.e., it believes that only the high-quality firm repurchases, but only the low-quality firm repurchases), $\hat{V}_{1L}(R) = Y_H + X$, $\hat{P}_{1L}(R) = \frac{Y_H + X}{N}$. Substituting β from b) into (1), I obtain the payoff given in lemma 1c). ■

Proof of Lemma 2

a) If both firms pay dividends at date 1, the market cannot distinguish firm types, so the market values of both firms are the same at $V_{1H} = V_{1L} = \overline{V}_0 = \frac{Y_H + Y_L + 2X}{2}$. At date 2, as all information is revealed, the cum-dividend value of firm H and firm L are $Y_H + X$ and $Y_L + X$ respectively.

b) The strategy pair $\{R, D\}$ is consistent with the market's belief $\{H, L\}$. Hence, the market value of high-quality firm increases to its fundamental value $Y_H + X$, and the market value of low-quality firm decreases to its fundamental value $Y_L + X$ at date 1.

c) In this strategy pair $\{D, R\}$, firm L sends false signal to the market so that the market mistakenly believes that the low-quality type is the high-quality type, and conversely, the high-quality type is the low quality type at date 1. ■

Proof of Lemma 3

a) If both firms invest in the new project at date 1, the market cannot distinguish firm types, so the market values of both firms are the same at $V_{1H} = V_{1L} = \overline{V}_0 = \frac{Y_H + Y_L + 2X}{2}$. The return from investment is then realized and made public at date 2.

b) Observing strategy pair $\{R, I\}$, the market correctly distinguishes the firm types as $\{H, L\}$, which is consistent with its posterior beliefs, at date 1.

c) Observing strategy pair $\{I, R\}$, the market incorrectly distinguishes the firm types as $\{L, H\}$, so firm H's expected return from investment is r_L at date 1.

d) Observing strategy pair $\{I, D\}$, the market correctly distinguishes the firm types as $\{H, L\}$, which is consistent with its posterior beliefs at date 1.

e) Observing strategy pair $\{D, I\}$, the market incorrectly distinguishes the firm types as $\{L, H\}$, so firm L's expected return from investment is r_H at date 1. ■

Proof of Lemma 4

To find firm H's best responses, (2), (15), and (11) are compared if firm L repurchases shares; (4), (12), and (18) are compared if firm L invests in the new project; and (5), (16), and (8) are compared if firm L pays dividends. Since it is obvious that (11)< (2), (18)< (4), and (8)< (5), paying dividends is a dominated strategy for firm H.

Subtracting (2) from (15) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X\left(\frac{Y_L - Y_H}{Y_H + Y_L}\right)\right] \tag{A1}$$

Since (A1) is negative, it follows that (2) > (15). Hence, firm Halso chooses to repurchase shares if firm L repurchases shares.Subtracting (4) from (12) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X r_H\right] \tag{A2}$$

Given $w_1 = w_2 = 1/2$, firm H's best response is to invest in the new project if $Xr_H \geq \left(\frac{Y_H - Y_L}{2}\right)$. If $Xr_H < \left(\frac{Y_H - Y_L}{2}\right)$, however, firm H's best response is to repurchase shares.Subtracting (5) from (16) yields

$$\alpha\left(w_1 X r_H + w_2 X r_H\right) \tag{A3}$$

Given $r_H > 0$, it follows that (A3) is positive. Hence, firm H will choose to invest in the new project. ■

Proof of Lemma 5

If firm H repurchases shares, (3), (14), and (10) are compared to find firm L's best response.Given $r_L < 0$, it follows that (14) < (10). Therefore, firm L pays dividends if firm H repurchases shares.Subtracting (3) from (10) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right)\right] \tag{A4}$$

Given $w_1 = w_2 = 1/2$, firm L will choose to pay dividends rather than repurchase shares if $X \geq \frac{Y_H + Y_L}{2}$. If $X < \frac{Y_H + Y_L}{2}$, firm L will choose to repurchase shares rather than pays dividends.Subtracting (10) from (14) yields

$$\alpha\left(w_1 X r_L + w_2 X r_L\right) \tag{A5}$$

Given $r_L < 0$, it follows that (14) < (10). Therefore, firm Lwill pay dividends if firm H repurchases shares.Then, (6), (13), and (17) are compared to find firm L's best response given that firm H invests in the new project.Subtracting (17) from (13) yields

$$\alpha\left[w_1\left(\frac{Y_H - Y_L}{2}\right) + w_2 X r_L\right] \tag{A6}$$

If $Xr_L \geq \left(\frac{Y_L - Y_H}{2}\right)$, firm L's best response is to invest in the new project. Firm L's best response is to pays dividends if $Xr_L < \left(\frac{Y_L - Y_H}{2}\right)$.Subtracting (6) from (13) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X\left(\frac{Y_H - Y_L + Y_H r_L}{Y_H}\right)\right] \tag{A7}$$

If $X\left(1 + r_L - \frac{Y_L}{Y_H}\right) \geq \left(\frac{Y_H - Y_L}{2}\right)$, firm L will choose to invest in the new project rather than repurchase shares. If $X\left(1 + r_L - \frac{Y_L}{Y_H}\right) < \left(\frac{Y_H - Y_L}{2}\right)$, however, firm L will choose to repurchase shares rather than invest in the new project.Subtracting (17) from (6) yields

$$\alpha\left[w_1\left(Y_H - Y_L\right) + w_2 X\left(\frac{Y_L - Y_H}{Y_H}\right)\right] \tag{A8}$$

Given $w_1 = w_2 = 1/2$, firm L will choose to pay dividends rather than repurchase shares if $X \geq Y_H$. If $X < Y_H$, firm L will choose to repurchase shares rather than pay dividends. ■

Proof of Lemma 6

Given that firm L invests in the new project, (12), (18), and (4) are compared to determine firm H's best response. Subtracting (18) from (4) yields

$$\alpha w_1\left(Y_H - Y_L\right) \tag{A9}$$

Since (A9) is positive, firm H will not pay dividends.Subtracting (4) from (12) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X r_H\right] \tag{A10}$$

When $w_1 = w_2 = 1/2$, firm H's best response is to invest in the new project if $Xr_H \geq \left(\frac{Y_H - Y_L}{2}\right)$ but to repurchase shares if $Xr_H < \left(\frac{Y_H - Y_L}{2}\right)$.Given that firm L pays dividends, (16), (8), and (22) are compared to determine firm H's best response. Subtracting (2) from (22) yields

$$\alpha w_2 X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) \tag{A11}$$

Since (A11) is obviously positive, firm H will not pay dividends.Subtracting (22) from (16) yields

$$\alpha\left[w_1\left(\frac{Y_H - Y_L}{2}\right) + w_2 X\left(\frac{Y_L - Y_H}{Y_H + Y_L}\right) + Xr_H\right] \tag{A12}$$

When $w_1 = w_2 = 1/2$, firm H's best response is to invest in the new project if $Xr_H \geq X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) - \left(\frac{Y_H - Y_L}{2}\right)$ but to repurchase shares if $Xr_H < X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) - \left(\frac{Y_H - Y_L}{2}\right)$.

Given that firm L repurchases shares, (15), (20), and (2) are compared to determine firm H's best response. Subtracting (20) from (2) yields

$$\alpha w_2 X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) \tag{A13}$$

Since (A13) is obviously positive, firm H will not pay dividends.

Subtracting (2) from (15) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X\left(\frac{Y_L - Y_H}{Y_H + Y_L}\right)\right] \tag{A14}$$

Since (A14) is negative, firm H's best response is to repurchase shares. ■

Proof of Lemma 7

Given firm H invests in the new project, (13), (17), and (6) are compared to find firm L's best response. Subtracting (17) from (13) yields

$$\alpha\left[w_1\left(\frac{Y_H - Y_L}{2}\right) + w_2 X r_L\right] \tag{A15}$$

When $w_1 = w_2 = 1/2$, firm *L*'s best response is to invest in the new project if $Xr_L \geq \left(\frac{Y_L - Y_H}{2}\right)$. Firm *L*'s best response is to pay dividends if $Xr_L < \left(\frac{Y_L - Y_H}{2}\right)$.Subtracting (6) from (13) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + w_2 X\left(\frac{Y_H - Y_L + Y_H r_L}{Y_H}\right)\right] \tag{A16}$$

When $w_1 = w_2 = 1/2$, firm *L* will choose to invest in the new project rather than repurchase shares if $X\left(1 + r_L - \frac{Y_L}{Y_H}\right) \geq \left(\frac{Y_H - Y_L}{2}\right)$. If $X\left(1 + r_L - \frac{Y_L}{Y_H}\right) < \left(\frac{Y_H - Y_L}{2}\right)$, firm *L* will choose to repurchase shares.

Subtracting (17) from (6) yields

$$\alpha\left[w_1(Y_H - Y_L) + w_2 X\left(\frac{Y_L - Y_H}{Y_H}\right)\right] \tag{A17}$$

When $w_1 = w_2 = 1/2$, firm *L* will choose to repurchase shares rather than pay dividends if $X < Y_H$. If $X \geq Y_H$, firm *L* will choose to pay dividends rather than repurchase shares.

Given firm *H* repurchases shares, (14), (10), and (3) are compared to find firm *L*'s best response. Subtracting (10) from (14) yields

$$\alpha\left[w_1\left(\frac{Y_L - Y_H}{2}\right) + Xr_L\right] \tag{A18}$$

Given $r_L < 0$, it follows that (14) < (10). Hence, firm *L*'s best response is to pay dividends rather than invest in the new project.Subtracting (3) from (10) yields

$$\alpha w_2 X\left(\frac{Y_H - Y_L}{Y_H + Y_L}\right) \tag{A19}$$

Since (A19) is positive, firm *L* will choose to pay dividends rather than repurchase shares. Hence, paying dividends is firm *L*'s best response if firm *H* repurchases shares. ■