

Share repurchase and takeover deterrence

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This article examines the use of share repurchase as a takeover deterrent. The main result is that in the presence of an upward-sloping supply curve for shares, the takeover cost to the acquirer can be greater if the target firm distributes cash through share repurchase than if it chooses either to pay a cash dividend or to do nothing. Because shareholders willing to tender in the repurchase are systematically those with the lowest valuations, the repurchase skews the distribution of remaining shareholders toward a more expensive pool. Examining the equilibrium behavior of all players in a stylized takeover game, conditions exist under which repurchase deters takeover. The example of capital gains taxation is then considered, when investors with different basis values impute different reservation values to their holding. Repurchase is more effective as a deterrent when it alters the marginal shareholder, when shareholder heterogeneity is large, and when the private benefit of control from takeover isn't too large.

1. Introduction

■ There has been explosive growth in the use of share repurchase in the past few years,¹ with much of the increase associated with contests for corporate control. Examples include Dayton Hudson's 1987 offer to repurchase 15% of its stock, described as "a defensive move . . . because it still feels vulnerable to a takeover" (*Wall Street Journal*, October 22, 1987). Polaroid's 1989 \$1.1 billion buyback was part of a "new strategy . . . in resisting the unwanted overtures of the Roy E. Disney family" (*WSJ*, January 1, 1989). "Sears, Roebuck and Company started buying back stock amid takeover rumors" in 1988 (*WSJ*, November 4, 1988). Indeed, the use of repurchase as a takeover deterrent is prevalent enough that SmithKline Beckman Corporation, announcing a tender offer for almost 20% of its stock, felt the need to state explicitly that it "isn't an anti-takeover measure" (*WSJ*, November 28, 1986).²

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¹ This is documented in Bagwell and Shoven (1989).

² Such proclamations are common: Graco asserted that its 1987 buyback "is not being driven by an anti-takeover defense" (*WSJ*, July 27, 1987), Holiday Inns declared that its 1986 buyback "isn't a response to a possible takeover attempt" (*WSJ*, June 8, 1986), and Household International avowed that its 1986 buyback "isn't a defensive measure" (*WSJ*, January 15, 1986).

The use of repurchase as a deterrent is not well understood. The standard finance paradigm posits common valuations for investors, in which case repurchase has no effect on the net profitability of takeover: the cost of takeover is reduced when cash is distributed, but the benefit of takeover is reduced by an equal amount. This limitation forces us to reconsider the assumptions underlying the standard theory. This reexamination is further motivated by the evidence in Bagwell (1990) that shareholders are willing to sell their shares at dramatically different prices, implying an upward-sloping supply curve for share equity.

This article demonstrates that observed repurchase activity can be understood as an implication of the hypothesis that the supply curve for share equity is positively sloped. The basic intuition is simple. When shareholders possess heterogeneous valuations, the shareholders willing to tender in a repurchase are systematically those with the lowest valuations. The repurchase skews the distribution of the remaining shareholders toward a more expensive pool, thereby raising the cost of takeover.

This informal idea becomes a complete theory when two further issues are addressed. First, it must be established that repurchase acts as a takeover deterrent in a fully specified equilibrium model. I develop a model with two firms, the target and the potential acquirer. The target firm's management initially decides whether to distribute cash to shareholders, and if so, whether in the form of repurchase or dividends. At the time it makes the cash distribution decision, the management realizes how each alternative affects the likelihood of subsequent takeover. Shareholders are also forward looking, rationally expecting the subsequent outcome when making all tendering decisions.

Second, while there is some empirical support for heterogeneous valuations, it must be established that this hypothesis is consistent with maximizing behavior and the pursuit of arbitrage profits. A variety of market frictions could give rise to heterogeneous shareholder valuations. This article begins with a general representation of heterogeneous valuations and is not wedded to any particular source of market frictions. This approach is subsequently confirmed with explicit consideration of the heterogeneity resulting from capital gains taxation. Heterogeneous basis values in the presence of capital gains taxation induce an upward slope, as owners with greater unrealized gains are more reluctant to sell. In this case, the presence of taxes on transactions precludes the homogenization of valuations.

With these considerations in mind, I develop an equilibrium model of share repurchase used as a takeover deterrent in the presence of heterogeneous shareholder valuations. The basic finding is that share repurchase does indeed increase the cost of takeover when it alters the marginal shareholder. Repurchase may therefore make a subsequent takeover less profitable than if the firm instead pays dividends or retains earnings. Moreover, repurchase is a more effective deterrent when shareholder heterogeneity is large, and when the private benefits of control are small. These conclusions hold in the general framework, as well as for the special case of capital gains taxation.

This article relates to three strands of existing literature. Previous explanations of repurchase have focused primarily on signaling, taxation, leverage, and the efficient use of funds.³ Dann (1981), Ofer and Thakor (1987), and Constantinides and Grundy (1989) argue that firms use share repurchase to signal information about increased expected cash flow and firm undervaluation. Bagnoli, Gordon and Lipman (1989) extend this to a takeover context, where repurchase deters takeover by persuading shareholders not to tender in the takeover. In contrast, the analysis developed here considers deterrence even in the presence of complete information, highlighting the alteration of the shareholder population.

Masulis (1980) and Vermaelen (1981) argue that in addition to signaling, repurchase can be motivated by marginal tax advantages of debt financing and capital gains. Stulz (1988) and Harris and Raviv (1988) show how debt-financed repurchase may make the

³ Only nonexclusionary repurchases are considered here. Shleifer and Vishny (1986) focus on targeted repurchase (greenmail), where a discriminatory repurchase is offered only to a subset of shareholders.

acquisition more difficult by increasing the fraction of voting rights controlled by management. Finally, Jensen (1986) argues that repurchase acts as a takeover deterrent by distributing funds that otherwise would be used less efficiently. This article differs from this previous work by isolating an alternative hypothesis: repurchase increases the cost of takeover by removing shareholders willing to tender at low prices, leaving the potential acquirer facing shareholders who require higher prices to sell their shares.

The second body of literature finds evidence consistent with the effectiveness of repurchase as a deterrent. In Dann and DeAngelo (1988), after eight of the eight defensive repurchases, the bidder was unsuccessful in acquiring control of the target; after ten of the remaining 25 defensive restructurings, the hostile bidder was successful in acquiring a substantial stake and board representation. Denis (1990) also documents that repurchases are associated with successful maintenance of target firm independence.

The third body of literature considers the main assumption underlying this article, shareholder heterogeneity. Bagwell (1990) documents significant upward slope for supply curves revealed through Dutch auction repurchases. Shleifer (1986) and Harris and Gurel (1986) document evidence consistent with less than perfectly elastic demand for stock revealed through firm inclusion in the S&P 500 Index. Bagwell (1988) and Stulz (1988) demonstrate that capital gains can generate shareholder heterogeneity. Brown (1988) examines the impact of this heterogeneity on the design of takeover offers, while Gay, Kale and Noe (1990) examine the impact on the design of repurchase offers. Finally, Bagwell and Judd (1989) show that financial decisions are relevant in the presence of heterogeneous shareholders.

The plan of the article is as follows. Section 2 presents the model and discusses the evidence of upward-sloping supply curves. Section 3 examines the effects of repurchase on the cost of takeover. In Section 4 a subgame perfect Nash equilibrium is characterized. General conditions supporting the key intuition are discussed. Section 5 considers the example of capital gains taxation. Section 6 concludes.

2. The model

■ This section develops the model. The sequence of events is as follows. There are two stages: the distribution stage and the takeover stage. In the distribution stage, the manager of the target firm chooses whether to distribute cash to its shareholders. If cash is distributed, D dollars is distributed either as dividends or through a share repurchase. If the manager chooses dividends, D is sent per share, because the number of shares outstanding is normalized to be one. If he instead chooses repurchase, a conditional tender offer specifies a price per share and a fraction of shares to be purchased, denoted γ .⁴

The shareholders then individually decide whether to tender their shares if there is a repurchase. Assume that if the offer is not fully subscribed, then it is canceled and a dividend of D per share is sent. If the offer is oversubscribed, then it goes *pro rata* (by SEC 13e-4); assume that if all shareholders sell, then the offer is deemed a dividend.⁵

The takeover stage follows the distribution stage. The potential acquirer decides whether to make a takeover bid for the target. Define V to be the liquidation value of the target if not taken over and if no distribution is made; let $V + R$ be the liquidation value after takeover if no distribution is made. It is assumed that these values are common knowledge. The increase in firm value after takeover may be due to synergy, the joining of resources or technologies, or the value of dislodging current inefficient management. If a takeover bid

⁴ Dann (1981) shows that tender offers are often conditional on the number of shares being tendered. Comment and Jarrell (1990) document that the tender offer is a frequent form of repurchase. Further, the motivation developed herein also arises in Dutch auction repurchases.

⁵ With taxation, IRS 302 requires that fully *pro rata* repurchases be treated as dividends. Moreover, the distribution of reservation values would be unchanged.

is made, the conditional tender offer specifies a price for the shares and some fraction of the shares to be purchased, denoted δ . This fraction must be at least α , the exogenously given fraction of outstanding shares necessary for corporate control.⁶ Assume that there are no transaction costs to an acquiring firm from making a tender offer. Therefore, the payoff to a potential acquirer is zero if he does not make a bid, or if a bid is made but is unsuccessful.

In response to the acquirer's offer, shareholders individually decide whether to tender their shares. Assume that takeover offers have *pro rata* allocation if oversubscribed, in keeping with SEC 13e-4.

□ **The supply curve.** A critical element of the analysis is that all potential buyers of the target firm's shares, including current management and the potential acquirer, face an upward-sloping supply schedule for equity. This section provides a functional form for the upward-sloping supply curve and gives some evidence consistent with an upward slope.

Shareholder reservation values are assumed to be heterogeneous. Reservation values can be aggregated to form a schedule of ask prices, the "supply curve." An upward-sloping curve requires at least two reservation values. Define $a(W, \Phi)$ to be the ask price associated with the Φ th share: the share with fraction Φ of the original outstanding shares held by agents with equal or lower reservation values. W is the per-share present value of the firm at liquidation, given expectations about future outcomes.⁷ Assume that $a(W, \Phi)$ is differentiable in its arguments. It is natural to assume that the ask is increasing in W , and by definition it is increasing in Φ .

The assumption of an upward-sloping supply curve is well motivated. Bagwell (1990) provides direct evidence of the magnitude of the upward slope for 32 firms that used Dutch auctions to repurchase stock between 1981 and 1988.⁸ In the Dutch auction, the company states the number of shares it will repurchase (on average, 18% of the outstanding shares) and sets a price range within which stockholders can offer to sell their shares (on average, from 3% to 17% above the preannouncement price). Shareholders fill out tendering schedules indicating how many shares they are willing to sell at each price within this range. The firm then compiles the tendering responses, constructing the supply curve for the stock. On average, 22% of shares were tendered within the price range. The firm pays the minimum price necessary to acquire the number of shares sought in the offer, on average 13% above the preannouncement price. The mean fraction reacquired was 15%, from the 17% tendered at or below the closing price. All shareholders who tender at prices at or below this closing price receive the closing price for their tendered shares.

The supply curves in this sample have distinct upward slopes. When bids are ranked from lowest to highest, the difference between the sixteenth percentile shareholder valuation and the first percentile shareholder valuation is 9% of the preannouncement market price. The average implied elasticity of the supply curve is 1.67. Standard curve fitting techniques confirm the significant upward slope. While this sample may not represent random firms, it does suggest that supply curves may be significantly upward sloping. Moreover, firms that utilize repurchase for the effect examined here may do so because they possess supply curves of significant upward slope.

Evidence consistent with upward-sloping supply curves is detected elsewhere. Bradley, Desai and Kim (1988) find that the premium paid in interfirm tender offers is increasing in the fraction of target shares purchased by the acquirer. Brown and Ryngaert (1990) find

⁶ The fraction of votes necessary for control is found in the corporate charter. This article does not consider how the optimal corporate rule is chosen.

⁷ The analysis is simplified by the assumption of common knowledge about V . Two-dimensional types, with heterogeneous beliefs about V in addition to heterogeneous objective characteristics, may make the aggregation of asks more complicated. As shareholders update their beliefs, the ordering of reservation values may change. The analysis would be identical only in special cases of heterogeneous beliefs about V that preserve the ordering of asks.

⁸ There were 52 Dutch auctions during this period.

very similar results in fixed-price repurchase tender offers. Shleifer (1986) also provides evidence suggestive of an upward-sloping supply curve, finding that the share prices of firms added to the S&P 500 Index increase at the announcement of the inclusion. The magnitude of the price increase is positively related to the increased buying of the shares by Index funds. Since being included does not signal any information about stock value, the findings suggest that the price increase is being driven by increased demand in the presence of an upward-sloping supply curve.

3. Repurchase increases the cost of takeover

■ The next two sections examine how the distributional choice affects the cost and profitability of takeover. Section 3 considers the effect of repurchase on the cost of takeover when shareholders don't change their beliefs about the likelihood of takeover. Section 4 then provides a subgame perfect equilibrium analysis of the profitability of takeover, when shareholders' beliefs react to the choices made by management.

At the time of the repurchase, the shareholders have expectations about the outcome of the subsequent takeover stage. Let variable Y take the value 0 if in the repurchase stage no takeover is expected, and take the value R if a successful takeover is expected to follow. Therefore, the firm liquidation value is expected to be $V + Y$, less the cash distributed in the repurchase. Under these expectations, the cost of repurchasing fraction γ of the shares is $D(\gamma, Y)$, implicitly defined in (1):

$$D(\gamma, Y) = \gamma a \left(\frac{V + Y - D(\gamma, Y)}{(1 - \gamma)}, \gamma \right). \quad (1)$$

Since the goal of this section is to evaluate the cost of takeover, it is assumed here that shareholders facing a takeover bid expect the offer to succeed, regardless of what shareholders expected in the repurchase stage. For a fraction acquired sufficient to ensure control (that is, $\delta \geq \alpha$), the cost of takeover is presented in equation (2):

$$c_R(\gamma, Y, \delta) = \delta(1 - \gamma) a \left(\frac{V + R - D(\gamma, Y)}{(1 - \gamma)}, \gamma + \delta(1 - \gamma) \right). \quad (2)$$

A successful takeover requires buying $\delta(1 - \gamma)$ shares, which is fraction δ of the shares left outstanding after repurchase. The type associated with the marginal share acquired is $\gamma + \delta(1 - \gamma)$, because the lowest fraction γ of shares were removed in the repurchase. We are interested in whether the target can use repurchase to drive takeover costs so high as to change the subsequent outcome of the takeover stage. The derivative of takeover costs with respect to the fraction repurchased shows the three effects of repurchase.

$$\frac{dc_R(\gamma, Y, \delta)}{d\gamma} = -\delta \frac{\partial a}{\partial W} \frac{\partial D}{\partial \gamma} + \delta(1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} + \delta a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right). \quad (3)$$

First, repurchase reduces the liquidation value by distributing $D(\gamma, Y)$; call this the liquidation effect. Second, repurchase buys out the lowest reservation shareholders, leaving behind a more expensive pool; call this the type effect. Third, repurchase may disproportionately alter shareholder asks; call this the disproportionate-adjustment effect. These effects are given by the first, second, and third terms respectively.

The type and disproportionate-adjustment effects reflect the deviations of this model from the standard paradigm. The type effect reflects the introduction of heterogeneous share valuations. With a common reservation value, this effect is zero. The disproportionate-adjustment effect reflects the introduction of market frictions, which cause a shareholder's ask to differ from the per-share liquidation value. If the ask does not equal W , then the ask may not change in the same proportion as the change in W resulting from the share repurchase.

To isolate the disproportionate-adjustment effect, consider the following example that assumes no liquidation or type effects. Assume that W equals $(V + R)/(1 - \gamma)$, independent of D . Assume that one shareholder holds the one outstanding share, with an ask equaling $W - 1$. Though it may appear incongruous that this shareholder will accept less than W to sell a share with a liquidation value of W , if market frictions preclude him from ever being able to obtain W , he will be willing to settle for less.⁹ Given this ask, the cost of acquiring one half of the share is $.5(V + R) - .5$. Since the acquirer pays $W - 1$ per share to obtain W , it is as if the acquirer gets a fixed discount per share of one dollar.

Suppose that the firm preemptively repurchases one-fourth of a share. The cost of acquiring one half of the remaining shares is now $.5(.75)(W - 1) = .5(V + R) - .375$. Because the total discount the acquirer receives is a function of the number of shares and not the value of those shares, repurchase reduces the total discount the acquirer receives by reducing the number of shares outstanding. The disproportionate-adjustment effect causes repurchase to increase the cost of takeover in this example because the elasticity of the ask with respect to W exceeds one. If the ask instead changed less than proportionately to the change in W , then the cost of takeover would be reduced by repurchase. In the absence of frictions, $a(W, \Phi) = W$, and this effect is zero.

Alternatively, the firm can distribute cash through dividends. The cost of takeover after dividends spending D dollars is presented in equation (4). It is the cost of buying δ shares, at the price on the supply curve representing the δ th type shareholder, assuming that shareholders who face the bid expect it to succeed.

$$c_D(D, \delta) = \delta a(V + R - D, \delta). \quad (4)$$

Dividends have only one effect on the cost of takeover, the liquidation effect, revealed through the derivative of cost with respect to the dividend size.

$$\frac{dc_D(D, \delta)}{dD} = -\delta \frac{\partial a}{\partial W}. \quad (5)$$

Thus, takeover is less costly as the dividend increases.

Alternatively, the firm can do nothing. The cost of takeover if no cash is distributed is presented in equation (6), and is the special case of zero dividends.

$$c_0(0, \delta) = \delta a(V + R, \delta). \quad (6)$$

Lemma 1 summarizes that takeovers are more costly if the firm retains earnings than if the firm pays dividends. This is the outcome of the liquidation effect.

Lemma 1. The cost of takeover is decreasing in the size of the dividend, and therefore a takeover is less expensive after a positive dividend than if the firm did nothing.

Next, to isolate the effect of repurchase on the shareholder population, dividends are compared to a repurchase that distributes the same amount of cash. While the liquidation value of the firm is therefore unaffected by the form of the distribution, the distribution of shareholder types may be affected. The type effect exists whenever the supply curve is increasing in type, and the repurchase alters the marginal shareholder. The disproportionate-adjustment effect reflects the relationship between the ask price and per-share liquidation value. In the standard paradigm, shareholders are homogeneous and the reservation values change proportionally to the liquidation value per share, so these terms disappear. In other market situations, these effects may exist.

If the supply curve is horizontal, as in the Modigliani-Miller world where transaction costs are zero, then the total cost of an acquisition of fraction δ of the shares remaining after repurchase is identical to the cost of an acquisition of fraction δ of shares following

⁹ This ask is a special case of the capital gains taxation example developed in Section 5.

dividends. That cost is $\delta(V + R - D)$, independent of the fraction repurchased γ . Theorem 1 shows the importance of relaxing the standard assumptions for understanding how repurchase makes takeover more costly, focusing on the type and disproportionate-adjustment effects.

Let $\Gamma(D, Y)$ be the fraction of shares repurchased to spend D .

Theorem 1. For a given δ , the cost of takeover after a repurchase exceeds the cost of takeover after dividends if

$$(1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} + a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right) > 0 \quad \forall \gamma \leq \Gamma(D, Y). \quad (7)$$

Proof. See Appendix A. The following observations can be made. First, when $\delta = 1$, repurchase causes no type effect, because the marginal shareholder has the highest reservation value regardless of the form of distribution. Whenever the fraction acquired is less than one, however, the type effect can exist. Second, if the elasticity of the ask with respect to the liquidation value per share equals one, there is no disproportionate-adjustment effect. Otherwise, this effect can be of either sign. Repurchase makes takeover more costly when the aggregate impact of any type and disproportionate-adjustment effects is positive. This is more likely when the marginal type is altered and the ask elasticity exceeds one.

Repurchase is next compared to retained earnings. In the Modigliani-Miller world where transaction costs are zero, the total cost of acquisition after retained earnings is less than after repurchase (as are the benefits). Repurchase reduces the total liquidation value by D dollars. The cost of acquiring fraction δ of the shares after retained earnings is $\delta(V + R)$, whereas after repurchase the cost is $\delta(V + R - D)$.

In a more general analysis, repurchase reduces the firm liquidation value but also may alter the median shareholder and the proportional claim. Therefore, for repurchase to deter takeover relative to retained earnings, the liquidation effect must be dominated. If so, then after repurchase the cost of acquiring the firm's ex-distribution liquidation value exceeds the cost of acquiring the firm's cum-distribution value.

Theorem 2. For a given δ , the cost of takeover is increasing in the fraction repurchased if

$$-\frac{\partial a}{\partial W} \frac{\partial D}{\partial \gamma} + (1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} + a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right) > 0 \quad \forall \gamma \leq \Gamma(D, Y). \quad (8)$$

Then, repurchase increases the cost of takeover.

Proof. See Appendix A. Theorem 1 gives conditions under which repurchase makes takeover more costly than dividends, while Theorem 2 gives conditions under which repurchase makes takeover more costly than doing nothing. Lemma 1 guaranteed that takeover is more costly after retained earnings than dividends because of the liquidation effect. It follows that if (8) holds then (7) also holds.

Corollary 1. If repurchase makes takeover more costly than retained earnings, it also makes takeover more costly than dividends. That is, (8) implies (7).

4. Equilibrium with a two-step supply curve

■ The previous section demonstrated how a successful repurchase can alter the distribution of shareholder reservation values to raise the cost of takeover. That analysis is incomplete, however, since shareholders did not have rational expectations with respect to the liquidation value or the gains from takeover. Will the repurchase be accepted? Maybe shareholders, seeing through the deterrence mechanism, will refuse the offer since they know of a potential acquirer who will subsequently offer a higher takeover bid. Does the effect on shareholder

type correspond to a reasonable equilibrium when multiple equilibria exist? It may be Pareto inferior for lower-reservation-value shareholders to accept the offer, given the existence of a Pareto-superior equilibrium where all reject the repurchase offer. Will the takeover be profitable? Repurchase also has an effect on the target firm's liquidation value, causing takeover benefits to be affected. A more complete analysis, including an explicit formulation of the supply curve and a backwards recursive solution, is required to resolve these issues. The primary finding of this section is that a subgame perfect equilibrium exists in which the current management chooses repurchase in order to successfully deter a takeover that otherwise would have occurred.

For tractability, assume two reservation values corresponding to two types of shareholders. Shareholders are of either low (L) or high (H) type ($L < H$), with fraction Θ of outstanding shares held by shareholders of the low type, where $\Theta \in (0, 1)$. For a given liquidation value W , the reservation value of a low-type shareholder is less than that of a high-type shareholder. We redefine the asks as a function of type:

$$\begin{aligned} a(W, \Phi) &= p(W, L) \quad \text{if } \Phi \leq \Theta \\ &= p(W, H) \quad \text{if } \Phi > \Theta. \end{aligned} \quad (9)$$

Two valuations imply that the supply curve is a step function. This is the simplest example of an upward-sloping supply curve, and it generates sufficient heterogeneity for illustrating the basic argument.

Without loss of generality, consider the case in which the control of the target is guaranteed by possession of a simple majority of shares, hence $\alpha = .5$. With a two-step supply curve, the repurchase type effect is possible only when at least half of the original shares are held by shareholders of the low type. If not, then regardless of the manager's distributional choice, the median shareholder has a high reservation price, hence repurchase cannot change the nature of the population the acquirer would face. Formally, assume that Θ , the original fraction of shareholders that sell at the lower price, is at least one-half.

The text that follows solves backwards for the equilibrium of this game and gives conditions and intuition for when repurchase acts as a takeover deterrent.

□ **The takeover stage.** In the takeover stage, the target firm has already made its distribution decision. Let γ be the fraction of outstanding shares acquired in the repurchase, and D the amount of cash that was distributed. γ and D summarize the distribution stage. While they are not independent, in the takeover stage they are exogenous. γ is zero and $D > 0$ when dividends were paid, while a successful repurchase from only low-type shareholders is represented by a γ and D both greater than zero.¹⁰ When retained earnings were chosen, $\gamma = D = 0$.

In response to a takeover offer, each shareholder decides whether to retain or tender his shares. Ask prices are a function of the expected liquidation value of a share, based on expectations about the simultaneous tendering decisions made by the other shareholders. Define the shareholders' expected liquidation value in the takeover stage to be $W(\gamma, D, Z)$. W is a function of the outcome of the distribution stage and whether the majority is expected to tender. Z , the expected synergy, takes the value zero if the takeover is expected to fail and takes the value R if success is expected. Shareholders, having seen γ shares repurchased and D distributed in the distribution stage, have an expected per-share liquidation value of

$$W(\gamma, D, Z) = \frac{V + Z - D}{(1 - \gamma)}. \quad (10)$$

¹⁰ This notation is used loosely, in that the only tendering responses explicitly considered are when only low types tender, everybody tenders, or nobody tenders. We preclude cases when only high-reservation-valued shareholders tender, since this never happens in equilibrium.

The best response of a shareholder of type T is to accept a takeover bid if offered at least his reservation price of selling, $p(W(\gamma, D, Z), T)$. If presented any higher offer, assume that a shareholder would tender even if he expects the offer to fail and hence no shares actually to be purchased. Under the elimination of weakly dominated strategies, the slightest chance that shares might be accepted motivates a shareholder to tender at any price above his asking price.

Next consider whether a potential acquirer makes a takeover offer. Define the potential acquirer's expected liquidation value in the takeover stage to be $W(\gamma, D, X)$. W is a function of the outcome of the distribution stage and whether the acquirer expects a majority to tender. X , the expected synergy, takes the value zero if the takeover is expected to fail and takes the value R if success is expected. The acquirer, having seen γ shares repurchased and D distributed in the distribution stage, has an expected per-share liquidation value of

$$W(\gamma, D, X) = \frac{V + X - D}{(1 - \gamma)}. \quad (11)$$

Assume that the potential acquirer obtains in present value some takeover gains from the fraction of shares δ he acquires, and some private benefit of control, J , which is independent of either the liquidation value or the fraction acquired.¹¹

$$b(W(\gamma, D, X), \delta) + J. \quad (12)$$

Takeover gains are increasing in his expectation of the liquidation value of the firm ($b_w > 0$) and may be a function of the fractional claim acquired.¹² Acquirer profit therefore is

$$b(W(\gamma, D, X), \delta) - \delta(1 - \gamma)a(W(\gamma, D, Z), \gamma + \delta(1 - \gamma)) + J. \quad (13)$$

Assume that to buy fraction δ of shares, the potential acquirer offers the minimum price sufficient to induce acceptance of the takeover offer for type δ shareholders.¹³ The acquirer takes as given the fraction of remaining shareholders with low reservation values, denoted η . $\eta = \Theta$ when $\gamma = 0$. If $\gamma > 0$, the $\eta = \max\left(0, \frac{\theta - \gamma}{1 - \gamma}\right)$. The acquirer selects the optimal δ at which to acquire control, where δ must be at least .5.

When η is at least one-half, the acquirer can offer either a price that captures only shareholders with low reservation values or a price sufficiently high that all shareholders are willing to tender. Acquirer profit is maximized at δ^* , the *maximum maximorum* of the objective functions:

$$\begin{aligned} \max_{\delta \in [.5, \eta]} & b(W(\gamma, D, X), \delta) - \delta(1 - \gamma)p(W(\gamma, D, Z), L) + J \\ \max_{\delta \in [\eta, 1]} & b(W(\gamma, D, X), \delta) - \delta(1 - \gamma)p(W(\gamma, D, Z), H) + J. \end{aligned} \quad (14)$$

The maximum profit of a successful bid given a repurchase of γ shares, if η is less than one-half, is found by selecting the δ that is the maximizing argument of the objective function:

$$\max_{\delta \in [.5, 1]} b(W(\gamma, D, X), \delta) - \delta(1 - \gamma)p(W(\gamma, D, Z), H) + J. \quad (15)$$

¹¹ Modelling the private benefit of control is common. See, for example, Grossman and Hart (1988), and Harris and Raviv (1988).

¹² Exclusionary devices like Grossman and Hart (1980) dilution are not necessary here, given the presence of benefits of control to the raider. For further discussion, see Bagnoli and Lipman (1988) or Grossman and Hart (1988).

¹³ This suggests no competition in the takeover market. See Fishman (1988) for discussion of takeover market bidding.

In deciding whether to make a takeover bid at this point, the potential acquirer compares the maximized value of the objective function to the zero profit he would obtain if he made no bid. If less than 50% of the shares would be tendered at every profitable offer price, then without loss of generality assume that no takeover bid would be made.

Once dominated strategies are eliminated, the equilibrium is unique in this stage, because $a_w > 0$ and synergies exist. Given shareholder tendering responses, the potential acquirer either successfully offers $p(W(\gamma, D, R), T^*)$, where T^* is the type associated with the optimal fraction acquired, or makes no bid.¹⁴ If the takeover price offered is below $p(W(\gamma, D, 0), T^*)$, then type T^* shareholders will not tender, regardless of expectations. If the price offered is between $p(W(\gamma, D, 0), T^*)$ and $p(W(\gamma, D, R), T^*)$, then shareholders of type T^* will sell only if they expect the takeover to fail. Since their tendering guarantees its success, however, this fails to be an equilibrium. If the price offered is at least $p(W(\gamma, D, R), T^*)$, then shareholders of type T^* expecting the takeover to succeed will sell, so the offer succeeds. It is not an equilibrium to refuse to tender here expecting a failed offer, for under that expectation it is a dominant strategy to tender. Therefore, once dominated strategies are eliminated, multiple equilibria do not exist with positive synergies in the takeover stage.

□ **The distribution stage.** The analysis of the takeover stage is sufficient to derive the outcome following dividends or retained earnings. Therefore, this section considers the choice of repurchase in the distribution stage.

Summarizing the expected future outcome by F , the expected liquidation price in the repurchase stage is $W(F)$. F is determined by the outcomes of the two stages. The repurchase is expected either to be accepted by low-reservation shareholders or to be canceled and followed by a dividend. Then, it is expected that there will be either no takeover bid or an acceptable one.

For each repurchase offer price that shareholders face given expectations F , D solves (16):

$$\gamma a(W(F), \gamma) = D. \quad (16)$$

Even after dominated strategies are eliminated, there is the possibility of multiple equilibria in the repurchase stage. For example, at a particular price offered in the repurchase, it may both be equilibrium for low types to refuse the offer if they expect others will also, or to tender their shares if they expect that low-reservation shareholders will accept. This possibility arises only when shareholder wealth is greater after dividends and subsequent takeover than after repurchase and deterrence. If a Pareto superiority criterion is imposed, it would rule out any equilibrium where a majority of shareholders tender at an offer price for which there exists an additional and Pareto-superior Nash equilibrium when they refuse. This selection criterion limits the parameter set under which repurchase acts as an effective deterrent, for under these parameters it generates the dividend/takeover outcome. This criterion may be reasonable, however, if courts disallow offers that are too low.

The manager considers in his repurchase choice the acceptance reaction to all possible offer prices. For type-effect deterrence, the repurchase must be at a price sufficient to motivate low-type shareholders to sell, yet not so high that the offer will go fully *pro rata*. This determines D , such that the low type is associated with the fraction repurchased and the high type is the prevailing majority after the repurchase.

□ **Repurchase as a deterrent.** Conditions are now given under which a takeover follows dividends or retained earnings, while repurchase deters any subsequent takeover attempt. The conditions also guarantee that D is of appropriate size to alter median type.

¹⁴ This analysis is similar to that found in Grossman and Hart (1980).

$$\begin{aligned}
& b(V + R, \delta_0^*) - \delta_0^* a(V + R, \delta_0^*) + J > 0 \\
& b(V + R - D, \delta_D^*) - \delta_D^* a(V + R - D, \delta_D^*) + J > 0 \\
& b\left(\frac{V + R - D}{1 - \gamma}, \delta_R^*\right) - \delta_R^* p\left(\frac{V + R - D}{1 - \gamma}, H\right) + J < 0 \\
& D = \gamma p\left(\frac{V - D}{1 - \gamma}, L\right) \\
& D \leq p\left(\frac{V - D}{1 - \gamma}, L\right)\theta \\
& D > p\left(\frac{V - D}{1 - \gamma}, L\right)(2\theta - 1). \tag{17}
\end{aligned}$$

These conditions induce a subgame perfect equilibrium in which the current management chooses repurchase in order to successfully deter a takeover. The first condition ensures that after retained earnings a takeover is profitable, when the acquirer has the choice of whether to purchase a majority of outstanding shares from only the low type or from all shareholders. The second condition ensures that after a dividend spending D dollars a takeover is profitable, when the acquirer has the choice of whether to purchase a majority of outstanding shares from only the low type or from all shareholders. The third condition ensures that after a successful repurchase spending D dollars a takeover is not profitable, when the acquirer must purchase a majority of outstanding shares from the high type. Anticipating these outcomes, low-type shareholders will tender into the repurchase because it is a dominant strategy to do so. The fourth and fifth conditions define the amount of cash used to repurchase fraction γ of shares from low-type shareholders. The last condition ensures that the median type is altered by the repurchase. The current management can therefore choose to repurchase rationally expecting its ability to deter the takeover.

5. Example: taxation

■ The previous section provided conditions under which repurchase acts as a deterrent by altering the median shareholder. Two issues remain. First, it must be shown that the hypothesis of heterogeneous reservation values corresponds to maximizing shareholder behavior and the absence of arbitrage opportunities. Second, it must be shown that the conditions given in (17) are not mutually exclusive. This section considers the example of capital gains taxation. It demonstrates that taxation can induce heterogeneous shareholder valuations and that the conditions for a subgame perfect equilibrium can be satisfied.

Taxes on capital gains induce shareholders with different basis values to tender at different prices, implying a supply schedule where only a fraction of shareholders will tender at some prices. In the presence of capital gains taxation, the price at which a shareholder is indifferent between holding his share or selling it and investing elsewhere is negatively related to the magnitude of the capital gain. Since the capital gain is the difference between the selling price and the purchase price (the basis value), type can be characterized by the negative of the basis value. Appendix B shows that a shareholder of type $-B$ has an ask of the form

$$p(W, -B) = W + \frac{\tau r(-B)}{(1 - \tau)(1 + r)} \tag{18}$$

where the tax rate is τ and the after-tax interest rate is r . The ask represents the price at which a shareholder is indifferent between holding the share until liquidation one period hence or selling today and investing the after-tax proceeds in an alternative investment

earning an after-tax rate of return r . This ask is increasing in the present value of per-share liquidation and type (that is, decreasing in the basis value).

Assume that all shareholders face an identical positive capital gains tax rate and that each shareholder has one of two basis values. Fraction $\Theta \geq .5$ of outstanding shares were purchased at the high basis value (i.e., low type), and $(1 - \Theta)$ were purchased at the low basis value (i.e., high type). There is no opportunity for arbitrage or transactions across shareholders with different basis values.

Assume that the acquirer pays taxation on capital gains in similar fashion to other shareholders. In Appendix B, Lemma 2 proves that takeover is only profitable in the taxation example if profits are positive when 50% of the shares are acquired. In what follows, therefore, profitability is evaluated at $\delta = .5$.

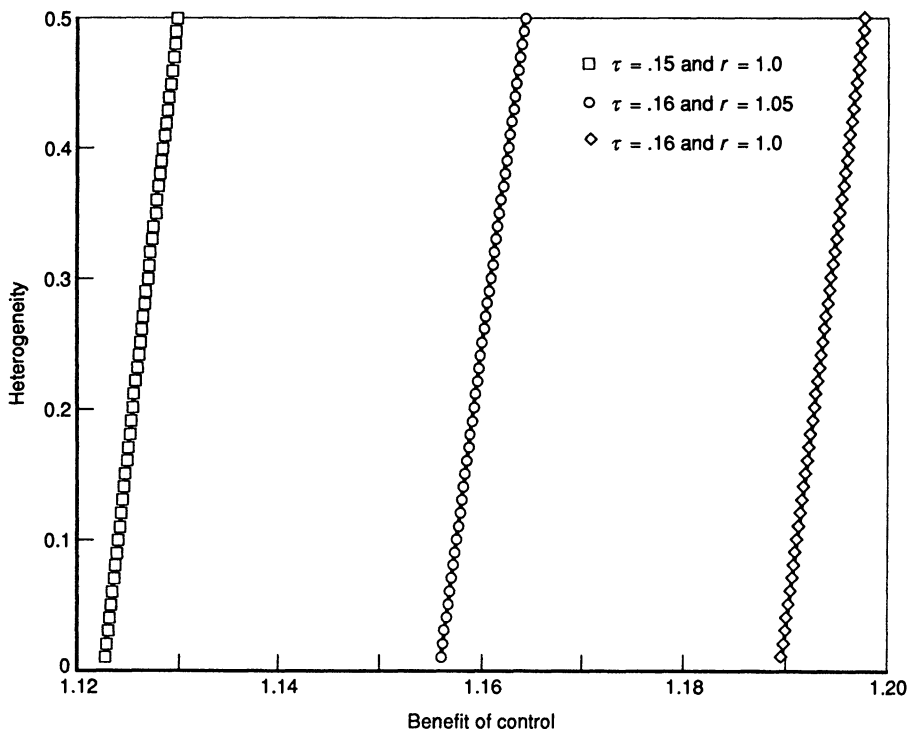
Figure 1 demonstrates comparative statics on the two important unobserved variables. The first variable, h , measures the relative magnitude of shareholder (basis value) heterogeneity. It is defined as

$$h = \frac{(H - L)}{V} \tag{19}$$

to capture both the difference in basis values and how the magnitude of this difference compares to the present value of the per-share liquidation value. The second variable, J , is the private benefit of control.

Parameters exist under which repurchase deters takeovers, as shown in Figure 1. For given values of the tax rate τ and the after-tax interest rate r , the region to the left of the constraint satisfies the sufficient conditions. With taxation, deterrence is more likely when the tax rate is higher and when the interest rate is lower. Moreover, Figure 1 demonstrates that shareholder heterogeneity makes deterrence more likely, while large private benefits of control make deterrence less likely. In contrast to repurchase, paying a dividend reduces

FIGURE 1



the capital gains “lock-in” (by reducing the difference between the purchase price and the sale price) and may make a hostile takeover easier.

6. Conclusion

■ This article shows how firms can deter hostile takeovers by repurchasing shares. Repurchase increases the cost that a potential acquirer pays to attain control by altering the distribution of shareholder reservation values. The crucial insight is that repurchase eliminates shareholders with the lowest reservation values, leaving the acquirer facing those with relatively higher valuations. The disproportionate adjustment of shareholders’ asks may further enhance the deterrence capabilities of repurchase.

The example of capital gains taxation has been shown to satisfy the sufficient conditions for a subgame perfect equilibrium. Moreover, deterrence is more likely when shareholder heterogeneity is large and when the private benefits of control are small. With taxation-induced heterogeneity, deterrence is also more likely when tax rates are high and when interest rates are low.

The apparent first-mover advantage afforded management is not vital to the results.¹⁵ Repurchase can similarly be used as a defensive tactic in reaction to a takeover offer. If the current manager can make a responsive offer before shareholders tender to the acquirer, he can outbid the acquirer for low-reservation shareholders. The repurchase, unlike the takeover, need not buy half of all shares; only enough are needed such that the median shareholder now is of higher type, with a valuation sufficiently high that takeover is no longer profitable.

The analysis presented here also forces us to reconsider the relevance of financial decisions in the presence of shareholder heterogeneity. Takeover deterrence is just one example of how the form of the distribution may affect subsequent outcomes. Because capital structure decisions and amendments to the corporate charter may have differential impact on the population of shareholders, they can also be chosen strategically. Future research needs to consider the potential impact of all firm decisions in light of shareholder heterogeneity.

Appendix A

■ The proofs of Theorems 1 and 2 follow.

Proof of Theorem 1. This proof shows that condition (7) is sufficient for the cost of takeover after repurchase of fraction $\Gamma(D, Y)$ to exceed the cost of takeover after dividends spending D .

$$\begin{aligned} (1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} + a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right) &> 0, \quad \forall \gamma \leq \Gamma(D, Y) \\ \leftrightarrow \delta(1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} \frac{\partial \gamma}{\partial D} + \delta a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right) \frac{\partial \gamma}{\partial D} - \delta \frac{\partial a}{\partial W} &> -\delta \frac{\partial a}{\partial W}, \quad \forall \gamma \leq \Gamma(D, Y) \\ \leftrightarrow \frac{\partial c_D(D, \delta)}{\partial D} < \frac{\partial c_R(\gamma, \delta)}{\partial \gamma} \frac{\partial \gamma}{\partial D} &\quad \forall \gamma \leq \Gamma(D, Y). \end{aligned} \quad (A1)$$

The cost of takeover after a zero repurchase equals the cost after a zero dividend, retained earnings. The cost of takeover after a positive repurchase exceeds the cost after dividends whenever this condition holds. *Q.E.D.*

Proof of Theorem 2. This proof shows that condition (8) is sufficient for the cost of takeover after repurchase of fraction $\Gamma(D, Y)$ to exceed the cost of takeover after retained earnings.

$$\begin{aligned} (1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} + a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right) - \frac{\partial a}{\partial W} \frac{\partial D}{\partial \gamma} &> 0, \quad \forall \gamma \leq \Gamma(D, Y) \\ \leftrightarrow \delta(1 - \delta)(1 - \gamma) \frac{\partial a}{\partial \Phi} + \delta a \left(\frac{\partial a}{\partial W} \frac{W}{a} - 1 \right) - \delta \frac{\partial a}{\partial W} \frac{\partial D}{\partial \gamma} &> 0, \quad \forall \gamma \leq \Gamma(D, Y) \end{aligned}$$

¹⁵ For a detailed analysis, see Bagwell (1988).

$$\leftrightarrow 0 < \frac{\partial c_R(\gamma, \delta)}{\partial \gamma} \quad \forall \gamma \leq \Gamma(D, Y). \quad (\text{A2})$$

The cost of takeover after a zero repurchase equals the cost after retained earnings. The cost of takeover after a positive repurchase exceeds the cost after retained earnings whenever this condition holds. *Q.E.D.*

Appendix B

■ **Tax-induced supply curve.** Assume that all individuals face an identical capital gains tax rate τ , which exceeds zero,¹⁶ and have an alternative investment opportunity with an after-tax rate of return r per period. Let the expected liquidation price per share be denoted U . The liquidation price is a function of expectations about the outcomes of the distribution and takeover stages. Liquidation occurs one period in the future, and this is known to all.¹⁷

The presence of capital gains taxation of realized profits implies that an individual shareholder differs in the prices at which he will buy and sell an identical share.¹⁸ The ask price for a shareholder is the price at which he is indifferent between holding his share or selling and investing his after-tax funds in the outside opportunity. If a shareholder purchased his share at a price B , and the share has liquidation value U , then the ask price is a function of U and B , $p(U, B)$, found by

$$(1+r)[p(U, B) - \tau(p(U, B) - B)] = U - \tau(U - B), \quad (\text{B1})$$

implying that

$$p(W, -B) = \frac{U}{1+r} + \frac{\tau r(-B)}{(1-\tau)(1+r)} \quad (\text{B2})$$

where $W = U/(1+r)$ and type is the negative of B .

An individual's ask is an additively separable function of the present value of per-share liquidation value and type, and it satisfies the form given in the text. When a price X is offered, those shareholders who sell have an ask price that is no higher than X . Correspondingly, the shareholders willing to sell have a basis value satisfying

$$B \geq \left(\frac{U}{1+r} - X \right) \frac{(1-\tau)(1+r)}{\tau r}. \quad (\text{B3})$$

High-basis-value shareholders are the most willing to sell, hence they are denoted the low type. Define the cumulative distribution of the basis values, $F(B)$, as the proportion of shares with basis values less than or equal to B .¹⁹ The fraction of shareholders δ willing to sell their shares at price X is a function of the expected liquidation price U and the tender offer price X :

$$\delta = 1 - F\left(\left(\frac{U}{1+r} - X \right) \frac{(1-\tau)(1+r)}{\tau r} \right). \quad (\text{B4})$$

Equation (B4) is the aggregate supply curve. Raising the offer price increases the number of shareholders who are willing to sell their shares. Since the ask price of each shareholder is monotonically decreasing in his basis value B , those with progressively lower basis values sell as the tender offer becomes increasingly generous. Therefore, the slope of the aggregate supply curve depends on the distribution of the basis values.

An individual's bid price $d(U)$ depends only on U . At this price an investor is indifferent between the final wealth he receives from buying a share and holding it until liquidation and his wealth if he invests the cost of purchasing a share in the alternative opportunity:

$$U - \tau(U - d(U)) = (1+r)d(U), \quad (\text{B5})$$

which implies that

$$d(U) = \frac{(1-\tau)U}{1+r-\tau}. \quad (\text{B6})$$

¹⁶ The intuition of the results survive the presence of many classes of holders simultaneously, including (but not exclusively) tax-free holders. However, as the following heterogeneity is sufficient to generate the supply curve, I do not give the more general derivation here. See Bagwell (1988) for more discussion.

¹⁷ It is a standard assumption that the firm ultimately liquidates. We refer to the liquidation date as one period in the future purely for notational simplicity.

¹⁸ Constantinides and Scholes (1980) examine whether through tax arbitrage strategies capital gains taxes may be avoided entirely, although transaction costs negate the effectiveness of the hedging strategy they propose. Poterba (1987) finds that the capital gains tax burden is borne by the majority of investors who realize capital gains.

¹⁹ Balcer and Judd (1987) examine how differing basis values can exist in a life-cycle model.

An individual will buy a share if it is offered to him for less than his bid price.

The ask can be written to represent the "lock-in" caused by the capital gains tax. Equation (B2) can be rewritten

$$p(W, -B) = \frac{(1-\tau)U}{1+r-\tau} + \frac{\tau r}{1+r} \left(\frac{U}{1+r-\tau} + \frac{-B}{1-\tau} \right). \quad (\text{B7})$$

Substituting the bid as found in (B6) as the basis value B in (B7), the second additive term is zero, so the asking price reduces to the bid price. Hence, the first additive term is the asking price of a shareholder who bought his share at the bid price. This investor's bid and ask are identical. The second term, which is positive for any shareholder who purchased his share at a basis value less than the bid price, is the premium necessary to compensate the shareholder for premature realization of the capital gain. The "lock-in" and necessary compensation are decreasing in the basis values.

At the market price, all holders have an ask that exceeds the market price and a bid below the market price. Differing basis values across shareholders is sufficient for the supply curve to slope upwards, lying between the lowest bid and the highest ask.²⁰ There is equilibrium as long as all asks exceed all bids, for those with the highest reservation prices will not buy from those shareholders with the lowest.

□ **Takeover profits.** Next consider the benefit to takeover in the tax case. There are two benefits to the potential acquirer from acquiring fraction δ of the shares: synergized share value from the fraction he acquires, and the private benefit of control. His before-tax benefit in present value is $\delta(V + R - D) + J$. To calculate his net after-tax proceeds, assume that the acquirer pays taxes on realization above basis value in a fashion identical to the shareholders, where the basis value is the tender offer price.²¹ Therefore, the net after-tax benefit of acquiring fraction δ , converted into present-value dollars, is

$$b(W, \delta) = \frac{\tau\delta}{1+r} (1-\gamma)a(W, \gamma + \delta(1-\gamma)) + \delta(1-\tau)(1-\gamma)(V + R - D). \quad (\text{B8})$$

Defining $z = (\tau - 1 - r)/(1 + r)$, takeover profit is

$$\Pi(W, \delta) = \delta z (1-\gamma)a(W, \gamma + \delta(1-\gamma)) + \delta(1-\tau)(1-\gamma)(V + R - D) + J. \quad (\text{B9})$$

With this profit function, takeover can be profitable only if at the price sufficient to get 50% of remaining shares, the profits exceed zero. To prove this, we need to prove an additional lemma.

Lemma 2. If $\Pi(W, .5) < 0$, then $\frac{\partial \Pi(W, \delta)}{\partial \delta} < 2\Pi(W, .5) < 0 \forall \delta \in [.5, 1]$. That is, negative profit at δ equaling .5 is sufficient for profit to be declining in δ for all δ at least .5.

Proof.

$$2\Pi(W, .5) = z(1-\gamma)a(W, \gamma + .5(1-\gamma)) + (1-\tau)(1-\gamma)(V + R - D) + 2J < 0 \quad (\text{B10})$$

implies that

$$\frac{\partial \Pi(W, \delta)}{\partial \delta} = z(1-\gamma)a(W, \gamma + \delta(1-\gamma)) + (1-\tau)(1-\gamma)(V + R - D) + \delta z(1-\gamma) \frac{\partial a}{\partial \Phi} \frac{\partial \Phi}{\partial \delta} < 0, \quad (\text{B11})$$

since $2J > 0$, $z < 0$, and a is increasing in δ . Therefore, if profit is negative at .5, then profit is declining in δ for all δ greater than or equal to one-half. *Q.E.D.*

To show Lemma 2 implies that profit is positive at 50% if anywhere, use proof by contradiction. Suppose that profit exceeds zero at some fraction above 50% but profit is negative at .5. This is a contradiction to $\frac{\partial \Pi}{\partial \delta} < 0$, which is true if $\Pi(W, .5) < 0$, by Lemma 2. Therefore, to consider whether profit to the potential acquirer is positive or negative, profit at 50% purchased is considered. *Q.E.D.*

□ **Sufficient conditions for equilibrium.** We require three conditions on takeover profits. The first two ensure that takeover is profitable after retained earnings and dividends, when a majority of the shares can be acquired from low-type shareholders. The third condition ensures that takeover is not profitable after a repurchase that shifts the median shareholder to one of high type.

²⁰ Bagwell (1988) shows that taxation can generate substantial upward slope.

²¹ This is assumed to avoid tax differences between the acquirer and the target, since that is not the focus here.

$$\begin{aligned} & \left(\frac{\tau}{1+r} - 1 \right) .5p(V+R, L) + .5(1-\tau)(V+R) + J > 0 \\ & \left(\frac{\tau}{1+r} - 1 \right) .5p(V+R-D, L) + .5(1-\tau)(V+R-D) + J > 0 \\ & \left(\frac{\tau}{1+r} - 1 \right) .5(1-\gamma)p\left(\frac{V+R-D}{(1-\gamma)}, H \right) + .5(1-\tau)(V+R-D) + J < 0. \end{aligned} \quad (\text{B12})$$

Last, D must be of correct magnitude to shift the median shareholder. That is,

$$\begin{aligned} D &= p\left(\frac{V-D}{(1-\gamma)}, L \right) \\ D &\leq p\left(\frac{V-D}{(1-\gamma)}, L \right)\theta \\ D &> p\left(\frac{V-D}{(1-\gamma)}, L \right)(2\theta - 1). \end{aligned} \quad (\text{B13})$$

In the simulation presented in Figure 1, the exogenous parameters take the values

$\theta = .55$	current value (V) = 100
$\gamma = .2$	current value (R) = 40
$L = 40$	

The conditions in (B12) and (B13) are not mutually exclusive, and they induce a subgame perfect equilibrium where repurchase successfully deters takeover. The region of consistent parameters is to the left of the constraint, for a given tax rate and interest rate.

References

- BAGNOLI, M. AND LIPMAN, B.L. "Successful Takeover without Exclusion." *Review of Financial Studies*, Vol. 1 (1988), pp. 89-110.
- , GORDON, R., AND ———. "Stock Repurchase as a Takeover Defense." *Review of Financial Studies*, Vol. 2 (1989), pp. 423-443.
- BAGWELL, L.S. "Dutch Auction Repurchases: An Analysis of Shareholder Heterogeneity." Working Paper No. 77, Northwestern University, Department of Finance, 1990.
- . "Essays on Financial Structure and Corporate Control." Ph.D. Dissertation, Stanford University, 1988.
- AND JUDD, K.L. "Transaction Costs and Corporate Control." Working Paper No. 67, Northwestern University, Department of Finance, 1989.
- AND SHOVEN, J.B. "Cash Distributions to Shareholders." *Journal of Economic Perspectives*, Vol. 3 (1989), pp. 129-140.
- BALCER, Y. AND JUDD, K.L. "The Effects of Capital Gains Taxation on Life-Cycle Investment and Portfolio Management." *Journal of Finance*, Vol. 42 (1987), pp. 743-758.
- BRADLEY, M., DESAI, A., AND KIM, E.H. "Synergistic Gains from Corporate Acquisitions and their Division between the Stockholders of Target and Acquiring Firms." *Journal of Financial Economics*, Vol. 21 (1988), pp. 3-40.
- BROWN, D.T. "The Construction of Tender Offers: Capital Gains Taxes and the Free Rider Problem," *Journal of Business*, Vol. 61 (1988), pp. 183-196.
- AND RYNGAERT, M. "Heterogeneous Shareholders: Evidence from Buybacks and Control Contests." Mimeo, University of Florida, 1990.
- COMMENT, R. AND JARRELL, G. "Signalling with Stock Buybacks: Dutch Auctions and Post-Crash Repurchase Programs." Mimeo, University of Rochester, 1990.
- CONSTANTINIDES, G.M. AND GRUNDY, B. "Optimal Investment with Stock Repurchase and Financing as Signals." *Review of Financial Studies*, Vol. 2 (1989), pp. 445-465.
- AND SCHOLES, M.S. "Optimal Liquidation of Assets in the Presence of Personal Taxes: Implications for Asset Pricing." *Journal of Finance*, Vol. 35 (1980), pp. 439-449.
- DANN, L.Y. "Common Stock Repurchases: an Analysis of Returns to Bondholders and Stockholders," *Journal of Financial Economics*, Vol. 9 (1981), pp. 113-138.

- AND DEANGELO, H. "Corporate Financial Policy and Corporate Control: A Study of Defensive Adjustments in Asset and Ownership Structure." *Journal of Financial Economics*, Vol. 20 (1988), pp. 87–127.
- DENIS, D.J. "Defensive Changes in Corporate Payout Policy." Mimeo, Virginia Polytechnic Institute, 1990.
- FISHMAN, M.J. "A Theory of Preemptive Takeover Bidding." *RAND Journal of Economics*, Vol. 19 (1988), pp. 88–101.
- GAY, G.D., KALE, J., AND NOE, T. "(Dutch) Auction Share Repurchases." Mimeo, Georgia State University, 1990.
- GROSSMAN, S.J. AND HART, O.D. "Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation." *The Bell Journal of Economics*, Vol. 11 (1980), pp. 42–64.
- AND ———. "One Share–One Vote and the Market for Corporate Control." *Journal of Financial Economics*, Vol. 20 (1988), pp. 175–202.
- HARRIS, L.E. AND GUREL, E. "Price and Volume Effects Associated with Changes in the S&P 500: New Evidence for the Existence of Price Pressures." *Journal of Finance*, Vol. 41 (1986), pp. 815–829.
- HARRIS, M. AND RAVIV, A. "Corporate Control Contests and Capital Structure." *Journal of Financial Economics*, Vol. 20 (1988), pp. 55–86.
- JENSEN, M.C. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *American Economic Review*, Vol. 76 (1986), pp. 323–329.
- MASULIS, R.W. "Stock Repurchase by Tender Offer: An Analysis of the Causes of Common Stock Price Changes." *Journal of Finance*, Vol. 35 (1980), pp. 305–319.
- MODIGLIANI, F. AND MILLER, M. "The Cost of Capital, Corporation Finance, and the Theory of Investment." *American Economic Review*, Vol. 40 (1958), pp. 261–297.
- OFER, A.R. AND THAKOR, A.V. "A Theory of Stock Price Responses to Alternative Corporate Cash Disbursement Methods: Stock Repurchases and Dividends." *Journal of Finance*, Vol. 42 (1987), pp. 365–394.
- POTERBA, J.M. "How Burdensome are Capital Gains Taxes?" *Journal of Public Economics*, Vol. 33 (1987), pp. 157–172.
- SHLEIFER, A. "Do Demand Curves for Stock Slope Down?" *Journal of Finance*, Vol. 41 (1986), pp. 579–590.
- AND VISHNY, R.W. "Greenmail, White Knights, and Shareholders' Interest." *RAND Journal of Economics*, Vol. 17 (1986), pp. 293–309.
- STULZ, R.M. "Managerial Control of Voting Rights: Financing Policies and the Market for Corporate Control." *Journal of Financial Economics*, Vol. 20 (1988), pp. 25–54.
- VERMAELEN, T. "Common Stock Repurchases and Market Signalling: An Empirical Study." *Journal of Financial Economics*, Vol. 9 (1981), pp. 139–183.