Why Do Firms Announce Open-Market Repurchase Programs?

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Empirically, a price increase accompanies the announcement of an open-market stock repurchase program, even though the announcement is not a commitment. In fact, for many announced programs no shares are ever actually repurchased. This article explores this puzzle. In the single-firm-type version of the model, the option that a firm grants itself by announcing a program does not generate announcement returns. In equilibrium, long-run gains from the informed trading that the option creates are offset by short-run costs from the market's accounting for this adverse selection. Based on this trade-off, I construct a signaling (two-type) model that can deliver announcement returns. In the separating equilibrium, good firms do not incur any cost when they announce programs. Their gains from informed trading in the long run offset the cost of announcement incurred in the short run. Mimicry is costly, because a bad firm's long-run gains from informed trading cannot compensate for the short-run cost of announcing.

The open-market stock repurchase program (henceforth "repurchase program" or "program") is a commonly used method for distributing corporate cash to shareholders. In a repurchase program, a firm buys back its shares in the market over a period lasting from months to years. In recent years, repurchase programs have become increasingly popular relative to other common forms of payout and now represent approximately 90% of the dollar value of all announced repurchases, or about the same value (compared with only 10–15% in the early 1980s) as all dividend payments.[1] Although they are not required to, most firms announce their repurchase programs in advance.

Unlike other common forms of share repurchase, such as Dutch auctions or fixed-price tender offers, repurchase programs do not

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[1] See Stephens and Weisbach (1998), Jagannathan, Stephens, and Weisbach (2000), and Grullon and Michaely (2002). This growth, however, is in addition to payouts in the form of dividends, rather than instead of them.

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precommit firms to acquire shares. In fact, frequently only a small fraction of the dollar value announced is actually repurchased, and many firms do not repurchase at all.[2] In spite of this, the empirical evidence is that the abnormal announcement return is positive 3% on average,[3] which means that the market regards a program announcement as good news.

Why is the announcement of a repurchase program accompanied by a price increase, even though the announcement commits the firm to nothing? Furthermore, why does this increase happen, given the evidence that a significant percentage of the quantity/dollar value announced is not eventually repurchased, and that a significant number of announcing firms do not repurchase at all? This article aims to answer these questions.

Ever since Miller and Modigliani (1961) demonstrated that in perfect markets a firm's payout policy is irrelevant, various theories have tried to explain why firms distribute cash in general and why they choose a specific payout form (dividend, stock repurchase) in particular. The majority of these explanations can be classified into three groups according to the frictions they build on: taxation, agency problems, and asymmetric information. The present study belongs to the third group, the group of asymmetric-information-based explanations, and hence this group will be the focus of the discussion. I argue that, while the existing asymmetric-information theories about payout policy apply to dividends and tender offers, their application to open-market programs is moot. I will present an asymmetric-information theory that does apply to repurchase programs.

The information-signaling theory suggests that firms are better informed than are investors about their type, and that good firms can distinguish themselves from bad firms by sending a costly signal. Separation requires that it will be more costly for bad firms than for good firms to send the signal. In the context of payout policy, it is suggested that distributing cash is the costly signal.[4] Since a repurchase program is a form of cash distribution, this theory could be applied to repurchase programs. The problem, however, is that if the program announcement is not a commitment, bad firms could mimic good ones. Bad firms could also

[2] Speculation in the press suggests actual repurchase rates of 30–40% (For example, see *The Wall Street Journal*, "Most buybacks are stated, not completed" March 7, 1995). Stephens and Weisbach (1998), and Jagannathan, Stephens, and Weisbach (2000) suggest an actual repurchase rate of 70–80%. Immediately after the market crash in 1987, many firms announced a repurchase program, but most of them did not actually repurchase. See Netter and Mitchell (1989).

[3] See Vermaelen (1981), Comment and Jarrell (1991), Ikenberry, Lakonishok, Vermaelen (1995), and Grullon and Michaely (2002). Average announcement return documented is 2.6–4.5%, depending on the study and sample period.

[4] For a review of signaling models in corporate finance see Daniel and Titman (1995). Models of signaling with dividends include Bhattacharya (1979), John and Williams (1985); Miller and Rock (1985), models of signaling with tender offer repurchases include Ofer and Thakor (1987), and Persons (1994).

announce a program, enjoy price appreciation today, and then refrain from repurchasing (as many firms, in fact, do). Reputation effects can provide an alternative explanation for the announcement return without a commitment to repurchase. This article, however, abstracts from reputation effects.[5]

Another asymmetric-information-based argument is suggested by Ikenberry and Vermaelen (1996). They argue that the repurchase program is an exchange option that gives a firm the ability to exchange its market value for its "true" value if, in the future, prices become lower than the true value. By announcing a program, a firm grants itself an option, the positive value of which is reflected in the announcement return.[6] Unlike the information-signaling theory, this theory does not suffer from the no-commitment problem, as the option has value without a firm commitment. I claim, however, that this notion that the repurchasing firm is granting itself a valuable option needs to be more closely examined in a context where a firm's announcement and its subsequent equilibrium repurchase behavior and price are directly connected.

In this article, I first demonstrate that, in the single-firm-type version of the model, if investors are rational, the option the firm grants itself by announcing a repurchase program does not generate an abnormal announcement return. Intuitively, the option value comes from the firm's ability to repurchase shares in the future based on private information. The informed trading this engenders, however, represents a zero-sum game between the firm and the market. The option, thus, does not *create* any value. If the announcement grants the firm a valuable option, then the market is short that option. During the repurchase period, the market knows it is exposed to adverse selection and is unwilling to pay high prices. Consequently, immediately after the announcement, the market price will reflect not only the value of the option, but also the anticipated decrease in future prices. In a competitive market, the option value and the expected loss from lower anticipated future prices will exactly offset each other in present value, and the abnormal announcement return will be exactly zero. Assuming, however, that a subset of the shareholders will face liquidity constraints in the repurchase period, the informed trading

[5] Empirically, while there are large reputation penalties for reducing dividends, this same phenomenon has not been documented for failure to complete previously announced repurchase programs [see Stephens and Weisbach (1998)].

[6] In the United States, firms are not required to announce their repurchase programs. However, provisions in the federal securities laws impose disclosure responsibilities to ensure that investors and the marketplace, in general, receive adequate information concerning the issuer purchases. Announcing their programs beforehand might be one way in which firms comply with these disclosure responsibilities [see Jagannathan, Stephens and Weisbach (2000)]. Announcing firms are not required to repurchase any shares, and there is also no reporting requirement on actual repurchases other than in the financial statements. In Canada, firms must announce their repurchase programs and must report actual repurchases on a monthly basis. In many countries, repurchase programs are forbidden.

associated with a program announcement transfers wealth from original shareholders who will later become liquidity constrained (short-term shareholders) to those who will not be constrained (long-term shareholders). This is because short-term shareholders suffer from lower selling prices, whereas long-term shareholders enjoy the informed trading gains.[7]

Next, I construct a signaling model that can deliver announcement returns. I introduce heterogeneity (two types) in the population of firms, where the value distribution of a good firm has higher expectation and higher variance than the value distribution of a bad firm.[8] Assuming that firms maximize the expected aggregate wealth of their original shareholders, and building on the wealth transfer effect described above, I characterize a signaling equilibrium in which good firms announce repurchase programs and bad firms do not. The model thus delivers announcement returns without a commitment on the firm's part to actually repurchase. The intuition for a separating equilibrium is as follows. The option to repurchase is more valuable to a good firm than to a bad firm because of the higher variance in its value distribution. Good firms announce a program. They are long the option to repurchase, whereas the market is short this option. Under rational expectations, market prices of a good firm's stock are set such that the losses of short-term shareholders exactly offset the expected gains of long-term shareholders. If a bad firm mimics its short-term shareholders will sell for a price that reflects the option value (informed trading) of a good firm, whereas its long-term shareholders will only enjoy the option value of a bad firm, which is lower because of lower variance. Because firms maximize the expected aggregate wealth of original shareholders, for a bad firm the "cost" of this option is higher than its value. Consequently, a bad firm is better off not announcing, and hence a separating equilibrium can hold. The tension between the difference in informed trading (i.e., the option value) and the difference in expected value between the types determines the equilibrium outcome. Separation will prevail if good firms can use the magnitude of their informed trading to deter bad firms from mimicking. In the separating equilibrium, good firms do not incur any cost when they announce a program, whereas bad firms find it too costly to announce. I suggest that this is what makes the programs popular: unlike most signaling stories, open-market-program signaling is costless for good firms.

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7 The wealth redistribution effects of open-market repurchase programs have been previously suggested in Brennan and Thakor (1990). In their model, stock repurchases (not only repurchase programs) transfer wealth from small uninformed investors to large informed investors.

8 The intuitive interpretation of this assumption is that good firms have more investment opportunities than bad firms, but that investment opportunities are associated with higher risk than assets in place. See Section 3 for related empirical evidence.

The contribution of this article is, thus, twofold:

1. It suggests that the Ikenberry-Vermaelen option (the option that an open-market repurchase program announcement engenders) generates announcement returns not because value is added through the trading gains associated with this option, but rather because these trading gains allow (good) firms to signal their value.
2. It also suggests that the open-market repurchase program is a nondissipative signaling tool.

To my knowledge, this article is the first to attribute this signaling form for repurchase programs.[9]

The model abstracts from reputation effects and ignores all forms of agency costs, transaction costs, and taxes. The tension is built on asymmetric information about the firm's intrinsic value. The main predictions, in addition to the positive announcement return, are that postannouncement expected returns will be relatively low in the short run and relatively high in the long run, and that postannouncement long-run returns will be correlated with the level of actual repurchase. These predictions are broadly consistent with the empirical evidence. In this analysis, with an open-market program, shares are purchased anonymously. This is the key difference between open-market programs and other payout forms. With tender offers, the firm's purchases are not anonymous. Dividends do not involve purchases at all.

The rest of this article is organized as follows. Section 1 presents a model in which repurchase programs serve to transfer wealth from short-term shareholders to long-term shareholders. In Section 2, a signaling model is built based on the model from Section 1. Section 3 compares the model predictions to the empirical evidence. Section 4 discusses robustness and suggests directions for further research.

1. A Base Model — One Firm Type

This section presents the single-firm-type version of the model for repurchase programs. It is demonstrated that, in this model, the announcement of a repurchase program does not affect the current stock price. However, the announcement transfers wealth from shareholders who will realize liquidity constraints in the near future (short-term shareholders) to shareholders who will not be constrained (long-term shareholders). In Section 2, heterogeneity in firm type will be introduced, and it will be demonstrated how a good firm can use this wealth transfer

[9] Models of nondissipative signaling in corporate finance include Ross (1977), Heinkel (1982), and Brennan and Kraus (1987). In these models, the firm's choice of capital structure serves as a costless signal of the firm's value. In Bhattacharya (1980) firms use dividends to costlessly signal earnings.

property to signal its type, thereby causing a positive announcement return.

1.1 The model — assumptions and notation

Assume there are three dates t_0, t_1, t_2, agents are risk neutral, the interest rate is zero, and there are no taxes or transaction costs. The firm/manager maximizes original shareholders' expected terminal wealth, and the firm is entirely equity financed.

The intrinsic value of the firm's assets, V_t, follows an exogenous random process as follows. At t_0, the firm owns assets in place with a safe (fixed) value θ and a risky project, the value of which is a random variable $\tilde{c}$. At t_1, with probability $q > .5$, the project value is realized to $\tilde{c} = C$, and with probability $1 - q$, it is $\tilde{c} = -C$, where $0 < C < \theta$. Accordingly, depending on the project value realization,

$$V_1 = \theta + C \quad \text{or} \quad V_1 = \theta - C. \tag{1}$$

Because agents are risk neutral and the interest rate is zero, then

$$V_0 = \theta + (2q - 1)C. \tag{2}$$

At t_2 the firm asset value is unchanged ($V_2 = V_1$). The firm is sold, and the proceeds are distributed among terminal shareholders. This setting is defined as "one type" because at t_0 the project's value distribution is unique.[10]

At t_0, there are N outstanding shares owned in dispersion by *original* shareholders. At t_1, just after the project value is realized, a subset of the original shareholders become constrained and must sell their shares at a price that is determined by the market. I assume that at t_0 original shareholders do not know whether they will become short-term shareholders (have to sell at t_1) or long-term shareholders (sell at t_2), but that the number of shares that will have to be sold at t_1 is some constant, K, anticipated ex ante by the market.[11] At t_2, when the firm is dismantled, the remaining $N - K$ shares of the original shareholders are sold along with the shares that are now owned by new shareholders. Short selling is not allowed at any date.

At t_0 the firm can announce a repurchase "program." The announcement grants the firm the option, but not the obligation, to repurchase a fixed number $\gamma < K$ of shares at t_1. The firm can participate in the sale at

[10] Section 2 will allow for two possible project value distributions, $\tilde{c}_B$ and $\tilde{c}_G$, and accordingly will have two firm types.

[11] That K is constant is a simplifying assumption that can be attained, for example, with a continuum of shareholders (can be shown using the law of large numbers.) Alternatively, since investors are expected value maximizers, randomizing K should not affect the model's intuition. The assumption that unconstrained original shareholders sell at t_2 can later be relaxed, since it is supported by the equilibrium.

t_1 only if it announces a program at t_0.[12] Thus, t_0 represents today (the time of announcement), t_1 represents the near future (the repurchase period), and t_2 represents the distant future (the postrepurchase period).

Information in the economy is asymmetric as follows. The firm has all available information at all dates. All other agents, (shareholders, and outsiders) have the same information as the firm at dates t_0 and t_2 . At t_1, however, they have no new information, that is, they do not observe the realization of $\tilde{c}$ (but information is still symmetric among them.)

The goal now is to seek a simple and tractable market mechanism that will take a repurchase period that in practice lasts one year (on average), put it into one trading day, and at the same time preserve the firm's ability to exploit private information. I do so by using an auction in which the firm receives priority over other participants. The sequence of events at t_1 is assumed to be as follows. First the project value and original shareholders' liquidity constraints are realized. Then the market for the stock opens in the form of an auction. In the auction ("the market mechanism"), the K shares are offered to $M \geq 2$ price bidders (henceforth "outsider bidders") who are potentially new shareholders.[13] Each outside bidder submits a price bid for *the whole* quantity K. They bid simultaneously, do not cooperate, and do not randomize their bids. If the firm announced a repurchase program at t_0, it participates in the auction at t_1 as well. Unlike the outside bidders, however, the firm places a price bid for only $\gamma < K$ shares.[14] Next, the selling price is set at the highest price at which demand meets supply (henceforth "the clearing price"). The bundle K is then allocated as follows. Bids higher than the clearing price are fully satisfied, and the remaining shares are allocated among bidders who bid at the clearing price in proportion to their bid.[15] The timing is described in Figure 1.

[12] For consistency of this assumption with the empirical evidence, see footnote 6.

[13] To avoid confusion, the term "bidders" refers to agents bidding for shares in the auction, not bidding their shares in the bid–ask sense. The assumption that outside bidders are new investors is only for simplicity of exposition. Results will not be affected if original shareholders, who do not realize liquidity constraints, can also bid; because, by assumption, the manger maximizes the expected proceeds from the sale of all t_0-shares.

[14] The SEC requires that the firm's nonblock purchases account for only a fraction of the trading volume [Rule 10–18b, see Johnson and McLaughlin (1997)]. In my model, this assumption allows the firm to repurchase γ shares (avoid rationing) when repurchasing is advantageous without affecting the equilibrium price. This assumption also assures existence. If outsiders could place price bids for quantities smaller than K or multiple bids at different prices and quantities, the equilibrium will not hold.

[15] The priority granted to the firm in the bidding process makes the auction effectively second price when the corporation is repurchasing and first price when it is not. Essentially, only the firm can place bids higher than the clearing price. Although in practice the firm does not have the priority it is given in this model, it has many trading days to exploit its private information slowly, without affecting the market price. An alternative market model in which the informed trader's bid affects the price (as in Kyle (1989), for e.g.) should not affect the basic intuition and would require that the market (maker) observe the order flow. In contrast, in this auction [as in other trading mechanisms like Glosten and Milgrom (1985), Rock (1986), and Noe (2002)], prices account for the possibility of informed trading but are independent of the order flow.

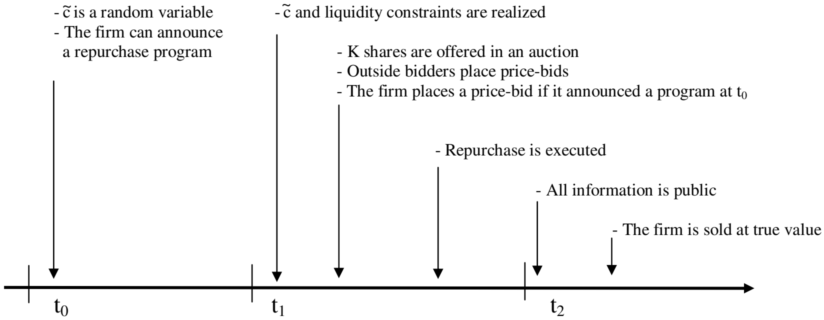

Figure 1
Time line

Assume that if the firm did not announce a program at t_0 (hence cannot participate) it must place a 0 price bid at t_1. Each outside bidder can avoid buying shares by submitting a 0 price bid. Similarly, a firm that announced a program at t_0 can avoid repurchasing at t_1 by bidding 0.[16] Since, by assumption, the firm must announce a program in order to participate, outside bidders (the market) always know whether the firm can place positive bids at the time they place their bid. Outside bidders who get to buy shares become new shareholders.

Consider the auction at t_1. At t_1, the realization of $\tilde{c}$ is known to the firm but not to outside bidders. Accordingly, define $b_m \in [0, \infty)$ as the strategy for outside bidder m in the auction at t_1, where the subscript $m \in \{1, \ldots, M\}$ identifies the bidder and define $b_f \equiv \{b_{fL}, b_{fH}\}$ as the strategy for the firm where $b_{fi} \in [0, \infty)$ and where the subscript $i \in \{L, H\}$ (low and high, respectively) indicates the realization of $\tilde{c}$. If the firm did not announce a program, then $b_f = \{0, 0\}$. Let $b \equiv \{b_1, \ldots, b_M\}$ denote the strategy profile for all outside bidders and let $d = \{b, b_{\mathrm{f}}\}$ denote the strategy profile for the game. Given a strategy profile d, let $\Psi_{mi}(d)$ and $\Psi_{fi}(d)$ denote the number of shares allocated to each outside bidder $m \in \{1, \ldots, M\}$ and the firm, respectively, when the state realized is $i \in \{L, H\}$. Last, assume that bids are unobservable at t_1 and become part of the public information only at t_2.[17]

Let P_0 denote the selling price at t_0, and define P_1, P_2 similarly. One can view P_0 and P_2 as being determined through a mechanism similar to the

[16] A situation in which all bidders place 0 bids is never an equilibrium, hence the auction never fails.

[17] Accordingly, the market does not learn whether a firm actually repurchased before t_2. Consistent with this assumption, Stephens and Weisbach (1998), Jagannathan, Stephens, and Weisbach (2000), and Cook, Krigman, and Leach (2004) document that, in the United States, it is practically impossible for outsiders to learn about the firm's actual repurchases in a timely manner, as there is no reporting requirement of actual repurchases other than in the financial statements.

auction mechanism described above. Let W_2 denote the terminal wealth of the original shareholders at date t_2. Shareholders' proceeds from the liquidation of their position can be viewed as their terminal wealth. The proceeds of original shareholders who become short-term shareholders are KP_1, and the proceeds of original shareholders who become long-term shareholders are $(N-K)P_2$. Thus,

$$W_2 = KP_1 + (N-K)P_2. \tag{3}$$

The firm's maximization problem is thus

$$\max_A \{E[W_2]\}, \tag{4}$$

where $A \in \{announce,\ do\ not\ announce\}$. Next I solve for equilibrium prices and for the terminal wealth of the different investor groups, both when the firm does and does not announce a program.

1.2 No repurchase program announcement

Assume first that the firm chooses not to announce a repurchase program[18]. In this case, although the firm knows the realization of $\tilde{c}$, this knowledge has no value because the firm cannot participate in the t_1 market (auction) for its stock. Consequently, the strategy profile for the game d is independent of the value realization and so are P_1 and the allocations of shares to each outside bidder. In contrast, at t_2 the realization of $\tilde{c}$ is public information, so P_2 and W_2 depend on the state realized at t_1.

Proposition 1. *In the economy with one firm type, without a program announcement,* $P_0 = P_1 = V_0/N = (\theta + (2q-1)C)/N$, $P_{2H} = \theta + C)/N$, *and* $P_{2L} = (\theta - C)/N$.

Proof. See Appendix A.

Next, I calculate the terminal wealth of shareholders. Without a program announcement, quantity risk does not enter the consideration (because there is no informed trading). Original shareholders who become short-term shareholders end up with $KP_1 = K(\theta + (2q-1)C)/N$. Because $P_1 = P_0$, their terminal wealth is equal to their initial wealth regardless of the value realization, hence their profit is always 0. Original shareholders who become long-term shareholders, end up with $(N-K)P_2$. They get $(N-K)(\theta + C)/N$ upon high realization, and $(N-K)(\theta - C)/N$ upon low realization. Their expected terminal wealth is $(N-K)(\theta + (2q-1)C)/N$, which is also equal to the initial value of their shares, and hence their

[18] It does not matter if the firm cannot announce, or can announce but chooses not to announce. This is because everybody has all available information at the time the program might be announced (at t_0), and hence no information is revealed by not announcing.

expected profit is 0. Thus, the expected terminal wealth of the original shareholders *as a group* is also equal to the initial value of their shares

$$E[W_2] = \theta + 2(1-q)C, \tag{5}$$

and their expected profit is 0. Since this is a zero sum game, this must be true also for the new shareholders. Indeed, new shareholders end up with $K(\theta + C)/N$ upon high realization and $K(\theta - C)/N$ upon low realization. Their expected terminal wealth is equal to the wealth they started with (invested): $KP_1 = K(\theta + (2q-1)C)/N$. To conclude, in the case without a repurchase program, the wealth of original shareholders who become short-term investors is never affected. Original shareholders who become long-term shareholders gain upon a high realization and lose upon a low realization. The expected wealth change of each investor group (short-term, long-term, new) is zero.

Because the interest rate is 0, investors are risk neutral, and the market is competitive, then the normal return in the market is 0. Consequently, a zero expected profit for new shareholders, and for original shareholders (as a group), is consistent with investor rationality. As demonstrated above, without a repurchase program, the expected profit of each subgroup of original shareholders (those who later become short-term shareholders, and those who later become long-term shareholders) is 0 as well. This will not be the case with program announcements.

1.3 Repurchase program announcement

Now suppose that information is asymmetric as above, but in addition, at t_0 the firm chooses to announce a repurchase program. The firm then bids a price for a fixed quantity $\gamma < K$ of shares, while outside bidders bid a price for the whole quantity K. Each bidder can refrain from repurchasing by bidding 0. As in the case of no program announcement, at t_1 an outside bidder still has only the t_0 information. Not so for the firm. Since the model now includes an informed bidder, the quantity of shares allocated to each outside bidder and the firm might depend on the value realization. Because $\gamma < K$, the auction mechanism dictates P_1 is always determined by an outside bidder, and is therefore independent of the value realization.

Proposition 2. *In the economy with one firm type, with a program announcement, P_0 is the same as in the case without a program announcement. The equilibrium price at t_1 is*

$$P_1 = \frac{q\frac{K-\gamma}{N-\gamma}(\theta + C) + (1-q)\frac{K}{N}(\theta - C)}{\frac{q\gamma(K-\gamma)}{N-\gamma} + K - q\gamma}, \tag{6}$$

and is lower than the t_1 equilibrium price without a program announcement. P_{2L} is the same as without an announcement, and

$$P_{2H} = \frac{(\theta + C) - \gamma P_1}{N - \gamma}. \tag{7}$$

P_{2H} is higher than the equilibrium price without an announcement. Consequently, the expected price at t_2, $E[P_2]$, is higher with a program announcement than without one.

Proof. See Appendix A.

Proposition 2 establishes that, with one firm type, P_0 is unaffected by the program announcement. This is because the option to repurchase shares, created by the announcement, adds no value to the original shareholders. Intuitively, because this is a zero-sum game, if the firm (original shareholders) is gaining an option by announcing a program, someone (new shareholders) must be short this option. Indeed, when the constrained (short-term) shareholders put their shares for sale at t_1, the firm exercises the option to buy only if the value realization is high, hence outside bidders are exposed to adverse selection (quantity risk). They end up with fewer shares when the value realization is high and more shares when the value realization is low. Because these outside bidders have rational expectations, they account for the adverse selection they are exposed to by shading their bids. The resulting P_1, in turn, is lower than the expected share value. In a competitive market, the option value and the loss from the decrease in P_1 exactly offset each other in present value, and hence the announcement return at t_0 is exactly zero. This result is summarized in the following corollary.

Corollary 1. *With one firm type, a repurchase program announcement does not affect the firm's value. Thus it does not generate an announcement return.*

Figures 2*a* and *b* illustrate the price path, with and without a program, respectively. Without a program announcement, $E[P_2] = P_1 = P_0$; whereas, with a program announcement, $P_1 < P_0$, and $E[P_2] > P_0$. This, in turn, implies that a program announcement transfers wealth from short-term shareholders to long-term shareholders. Intuitively, since the expected profit of new shareholders must be 0, changes in P_1 and in $E[P_2]$ generated by the announcement only transfer wealth from original shareholders selling at t_1 to original shareholders selling at t_2.

Ikenberry and Vermaelen (1996) suggest that stock prices increase around the time of program announcements because the option that the firm grants itself adds value. Their model does not consider how prices might account for informed trading. They start with prices that reflect expected value and then suggest that, following a program announcement, short-term shareholders sell for the same price, while long-term

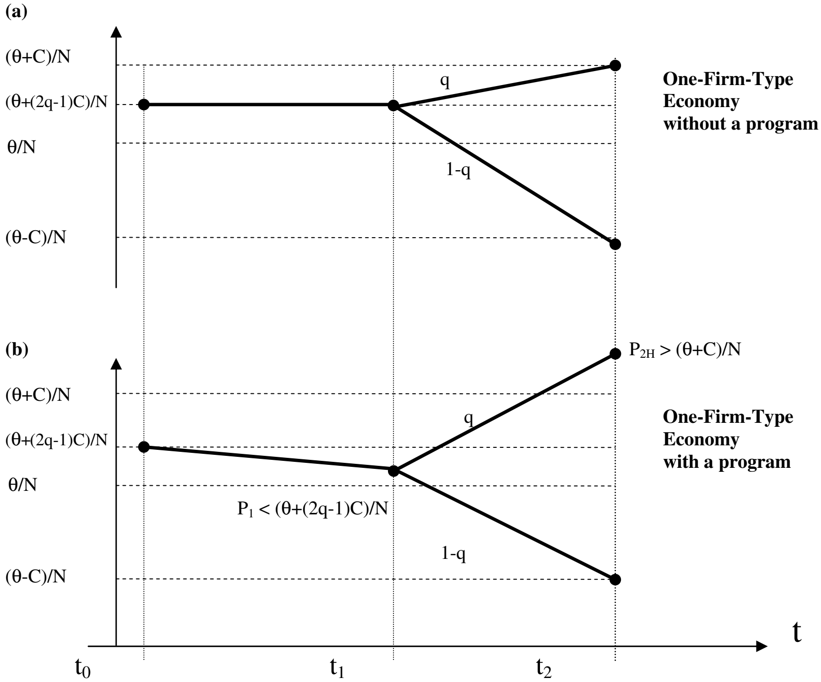

Figure 2
Price path diagram—one firm Type
The diagram describes the stock price path in the one-firm-type economy with and without a program announcement. Without a program announcement (graph a), the price does not reflect the value realization until t_2. With a program announcement (graph b), the t_1 price is lower than the expected value, because the market takes the adverse selection into account. At t_2, if the value realization is high, the price reflects gains from adverse selection. If the value realization is low, the firm does not repurchase and the t_2 price reflects only the value realization.

shareholders sell for prices that reflect gains from the firm purchases (they too have only the firm informed). Hence they argue that upon announcement the stock price must increase to reflect the expected gain. Here, I extend Ikenberry and Vermaelen's "partial equilibrium" model by allowing a feedback from optimal repurchasing behavior to price. My model starts at a primitive level and demonstrates that, given a program announcement, a rational market mechanism may not support the equilibrium prices they take as given. This is because rational investors take the option into account, and thus this option by itself may not explain the abnormal announcement return. Rather than granting itself an option, the firm is "buying" an option. Short-term shareholders pay the option cost during the repurchase period (t_1) because they sell for lower prices; long-term shareholders enjoy informed trading gains in the long-run (t_2). Since the option is fully accounted for by the market at t_1, and since the manner in which wealth is redistributed at t_1 is unknown at t_0, there is no mechanism for the repurchase program announcement to affect P_0.

Next, I calculate the terminal wealth of shareholders in the case with a program announcement in order to demonstrate the wealth transfer effect. Because of informed trading, the quantity risk should be considered. Since $P_1 < P_0$, short-term shareholders always lose a fixed amount $K(P_0 - P_1)$ regardless of the value realization. Long-term shareholders end up with the same wealth as in the case of no program announcement if the realization is low, but they end up with a higher wealth if the realization is high, because now $P_2 > (\theta + C)/N$. Their expected terminal wealth is, thus, higher than without an announcement. New shareholders buy at P_1 and sell at P_2. Although $E[P_2] > P_1$, they end up with the same expected terminal wealth as without an announcement, because they are exposed to quantity risk: they buy K shares upon low realization, but only $K - \gamma$ shares upon high realization. In fact, since new shareholders must have 0 expected gain, the fixed loss of the short-term shareholders is exactly equal to the expected gain of the long-term shareholders. Thus, the expected profit of the original shareholders as a group is 0, with or without an announcement. This is reflected in the fact that the announcement does not affect P_0.

The above analysis implies that, in comparison to the case without a repurchase program announcement, here original shareholders who become short-term shareholders are worse off. They suffer a fixed loss, instead of making a fixed 0 profit. Original shareholders who become long-term shareholders are better off because their expected gain is positive. Their terminal wealth distribution, however, has a higher variance, and is positively skewed. Their *expected* gain is equal to the fixed loss of short-term shareholders. Hence the aggregate wealth of original shareholders is unaffected by the announcement. The expected profit of new shareholders is always 0 because they compete with each other but do not have to trade. Their terminal wealth distribution, however, has a higher variance and is negatively skewed. To conclude, although the option to repurchase shares creates no value, it transfers wealth from short-term shareholders to long-term shareholders.

In the analysis here [as in Ikenberry and Vermaelen (1996)], with an open-market program, shares are purchased anonymously. This is the key difference between open-market programs and other payout forms. With tender offers, the firm's purchases are not anonymous. Dividends do not involve purchases at all. The wealth transfer from short-term shareholders to long-term shareholders, is also unique to open-market programs (and to this model), as an announced tender offer or dividend is not adapted to far-away future inside information, whereas an open-market program running over a year or so could certainly be.

Example. Let $N = 100$, $\theta = 1000$, $q = .75$, $C = 500$, $K = 30$, and $\gamma = 20$. Then $V_0 = \theta + (2q - 1)C = 1250$ and $P_0 = 12.5$.

At t_0, the firm announces a program for $\gamma = 20$ shares. At t_1, $K = 30$ shares are offered by the constrained shareholders. The firm value at t_1 just before the repurchase is performed is either 5 or 15 per share, depending on the state realized, but only the firm knows which. From Proposition 2, $P_1 = 10.5555$, $P_{2H} = 16.1111$, and $P_{2L} = 5$.

The firm bids higher than $P_1 = 10.5555$ if it observes a high state (positive value shock) in which it is allocated 20 shares and pays $P_1 = 10.5555$; it bids lower than $P_1 = 10.5555$ if it observes a low state (negative value shock) in which case it buys 0 shares. Outside investors bid and pay $P_1 = 10.5555$ regardless of the state realized. They get to buy only 10 shares if the state is high and 30 shares if the state is low. Their expected gain is:

$$.75 \times 10 \times (16.1111 - 10.5555) + .25 \times 30 \times (5 - 10.5555) = 0.$$

Consider the shareholders who hold on to their shares at t_0. With probability $K/N = 30\%$, they will become constrained and sell their shares at t_1 and get 10.555 per share. With probability $(N - K)/N = 70\%$, they sell their shares at t_2 and get 5 per share if the state is low and 16.1111 per share if the state is high. Their expected proceeds per share are

$$.30 \times 10.5555 + 0.7 \times (.25 \times 5 + .75 \times 16.1111) = 12.5.$$

Note that the stock price dynamics do not admit the possibility of arbitrage. For instance, suppose shareholders try to sell their shares at t_0 and buy them back at a lower price at t_1. When they sell at t_0, they get 12.5 per share. When they come to buy back at t_1, there are 30 shares offered. They get to buy 30 shares if the value is 5 per share but only 10 shares if the value is 15 per share. With probability $q = .75$, the state realized at t_1 is high. They pay $10 \times 10.5555 = 105.5555$ at t_1, and at t_2 they sell for $10 \times 16.1111 = 161.1111$. Their gain is $161.1111 - 105.5555 = 55.5555$. With probability $q = .25$, the state realized at t_1 is low. They pay $30 \times 10.5555 = 316.6667$ at t_1, and at t_2 they sell for $30 \times 5 = 150$. Their gain is $150 - 316.6666 = -166.6667$. Their expected gain from buying the shares back at t_1 is $.75 \times 55.5555 + .25 \times (-166.6667) = 0$. Thus, they do not make arbitrage profits.

The rest of this section investigates how P_1 changes with γ, K, C, and q. This comparative-statics analysis is important since the wealth transfer from short-term to long-term shareholders is performed through (the decrease in) P_1.

Proposition 3. *In the economy with one firm type, with a repurchase program announcement, P_1 is decreasing in γ and increasing in K and q. P_1 is increasing in C for all $\gamma \in (0, \gamma_c)$ and is decreasing in C for $\gamma \in (\gamma_c, K)$,* *where*

$$\gamma_c = K\frac{1}{1+\frac{1-q}{2q-1}\frac{N-K}{N}}. \tag{8}$$

Proof. See Appendix A.

Intuitively, as γ (the program size) increases, informed trading (hence quantity risk) increases. Since the expected profit of new shareholders must be 0, the price that they are willing to pay at t_1 decreases.[19] As K (the trading in the stock at t_1) increases, more of the pie is left for new shareholders upon high value realization, while their loss per share upon low realization is unaffected. Since in a competitive market they cannot make a positive profit, the market price at t_1 increases. Similarly, as q (the probability for the high state) increases, the expected share value increases while informed trading decreases (because the variance decreases for $q > .5$). In turn, the market price at t_1 increases. Last, increasing the parameter C has two opposite effects on the market price at t_1. On the one hand, the expected firm value increases (since $q > .5$), whereas on the other hand, the variance increases; hence the informed trading gains are higher (the value of the option that the firm is long and the market is short increases). For high values of γ, the former effect is stronger, and consequently the higher the C, the lower the price new shareholders are willing to offer. For low values of γ, the latter effect is stronger, and the situation is reversed. When $\gamma = \gamma_c$ these effects offset each other and a change in C has no effect on the market price at t_1.

2. A Signaling Model — Two Firm Types

In this section, heterogeneity in firm type is introduced. A separating equilibrium in which good firms announce repurchase programs and bad firms do not is characterized. Unlike in the one-type setting, here the price increases upon announcement, since in equilibrium the announcement signals type.

Assume that a firm's type is characterized by the project value $\tilde{c}_j$ where $j \in \{B, G\}$, $C_j \in (0, \infty)$ and $C_B < C_G$. Since $q > .5$, B-type firms are low-valued and G-type firms are high-valued (henceforth "bad" and "good," respectively). Essentially, I assume here that risk is positively correlated with expected return, but note that this assumption is about the production technology, not about equilibrium prices. The intuitive interpretation is that good firms have more investment opportunities than bad firms, but that investment opportunities are associated with higher risk than assets in

[19] This, in turn, implies that the larger the announced quantity, the larger the wealth transfer from short-term shareholders to long-term shareholders.

place are. The population of firms is distributed such that a fraction p of the firms are good, and a fraction $1-p$ of the firms are bad. In what follows, I will investigate how the results from Section 2 vary with heterogeneity in types.

Assume that information in the economy is as follows. At all dates the firm has all available information. In particular, at t_0 it knows its type $j \in \{B, G\}$ (and thus the distribution of its future value). At t_1 it knows the realization of $\tilde{c}_j$. At t_2 there is no new information, and thus the firm has the same information as at t_1. Unlike the firm, the market cannot tell at t_0 if a firm is good or bad, but it knows the distribution of the population of firms, and it knows the value process of each type. At t_1 the market has no new information. At t_2 all information is public. Information is thus twofold asymmetric at t_1: The market does not know the firm's type, and it also does not get to observe the state realization.

Unlike in the base model, in the two-type model, information is asymmetric at t_0 as well. There is, thus, a difference in market beliefs when the firm cannot announce a repurchase and when the firm can announce but chooses not to. Accordingly, I will investigate the prices and the terminal wealth under two different asymmetric-information economies. In the first, repurchase programs are forbidden; in the second, they are allowed. The purpose of examining the no-program economy is to learn how the ability to announce changes wealth distribution among investor groups.

2.1 No program-signaling ability

Suppose first that repurchase programs are forbidden, that is, firms cannot signal. As in the base model, d is independent of the value realization, and $P_{1L} = P_{1H} \equiv P_1$.

Proposition 4. *In the economy with two firm types and no program-signaling ability,* $P_0 = E_p[E[V_2]]/N$, *where* $E_p[.]$ *is the expectation with respect to the distribution of the population of firms.* $P_1 = P_0$ *and* $P_{2ji} = V_{2ji}/N$, *where* $j \in \{B, G\}$ *depending on the firm's type and* $i \in \{L, H\}$ *depending on the value realization at* t_1.

Proof. An immediate result of Proposition 1.

Figure 3*a* illustrates the price path for each type in the no-program economy. The solid line illustrates the price path for good firms, and the dotted line describes the price path for bad firms. At t_0 and t_1, the stock price of both types reflects the expected value with respect to the distribution of firm population and project value. At t_2, both the type and the value realization become public information, and the price reflects true value.

As in the economy with one firm type and without a program, in the two-types no-program economy, terminal wealth is not affected by quantity risk (because there is no informed trading). It is easy to show that

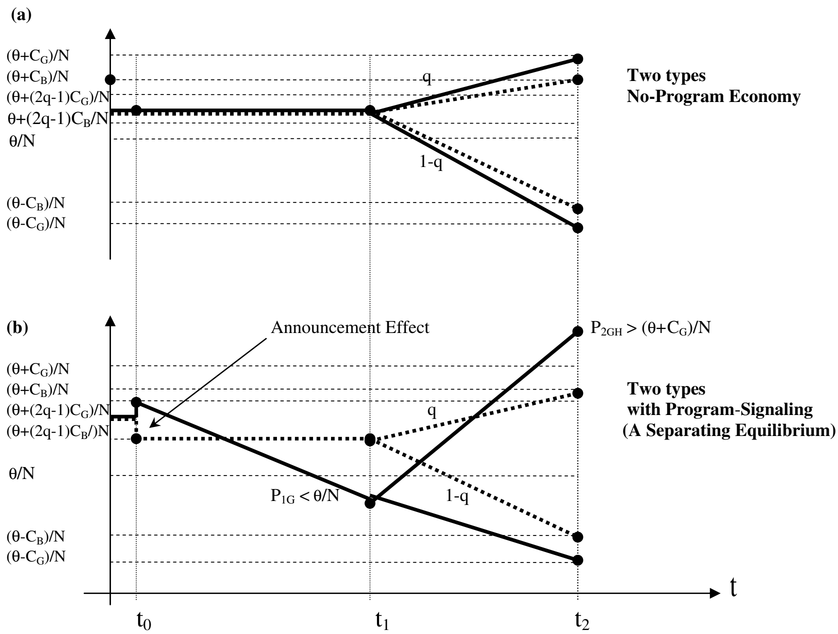

Figure 3
Price path diagram — two firm types
The diagram describes the stock price path in the two different two-types economies. The solid line depicts the price path for good firms, and the dotted line depicts the price path for bad firms. In the no-program economy (graph a), at t_0 and t_1, the stock price of both types reflects the expected value with respect to the distribution of firm population and project value. At t_2, both the type and the value realization become public information, and the price reflects true value. In the program-signaling economy (graph b), at t_0, good firms announce a program and enjoy positive announcement returns. Bad firms do not announce, and their stock price decreases to reflect their expected stock value. At t_1, the stock price of a good firm reflects adverse selection, and the stock price of a bad firm is unchanged. It is shown in the proof of Proposition 6 that in a separating equilibrium $P_{1G} < \theta/N$. At t_2 , the stock price of a good firm reflects gains from adverse selection if the value realization is high. Otherwise it reflects only the value realization. The stock price of a bad firm at t_2, reflects only the value realization regardless of whether the value realization is high or low, because a bad firm does not announce, hence, cannot repurchase.

because types are unobservable at t_1, the short-term shareholders of both types get a fixed amount $KP_1 = KP_0 = K[\theta + (2q-1)(pC_G + (1-p)C_B)]N$ regardless of type and value realization. Short-term shareholders of bad firms, thus, gain at the expense of short-term shareholders of the good firms. Long-term shareholders of each type get the value of their shares according to the type and the value realization, since at the time they sell their shares all information is known. Therefore, as a group, shareholders of bad firms gain at the expense of the shareholders of the good firms. Because the market is competitive, the expected gain of new shareholders must be zero. Indeed, they always pay KP_1 (without a program they are not exposed to quantity risk), and their expected terminal wealth is $KE_p[E(P_2)] = KP_1$.

2.2 Program-signaling

Now suppose that the information setting is asymmetric as above, but in addition, at t_0 the firm can announce a repurchase program as in the base model. As before, outside bidders cannot condition their bids on the value realization, but the firm can if it announces. I characterize a separating equilibrium in which good firms announce a repurchase program, and bad firms do not.

Definition 1. *A separating equilibrium in the economy with two firm types is an equilibrium in which good firms signal their type by announcing a repurchase program of $\gamma < K$ shares, and bad firms do not.*

Note that the above definition relates only to the announcement and not to the actual repurchase. That is, the search is for a separating equilibrium in which only good firms announce a program at t_0 and at t_1 repurchase or not depending on the cash flow realization, whereas bad firms do not announce at t_0 and, hence, never repurchase at t_1.

Assume a separating equilibrium exists. Given separation, the following proposition characterizes the equilibrium prices.

Proposition 5. *In a separating equilibrium, at t_0, $P_{0j} = V_{0j}/N = (\theta + (2q-1)C_j)/N$ where $j \in \{B, G\}$. At t_1,*

$$P_{1G} = \frac{q\frac{K-\gamma}{N-\gamma}(\theta + C_G) + (1-q)\frac{K}{N}(\theta - C_G)}{\frac{q\gamma(K-\gamma)}{N-\gamma} + K - q\gamma} \tag{9}$$

and $P_{1B} = P_{0B}$. At t_2, $P_{2GL} = (\theta - C_G)/N$,

$$P_{2GH} = \frac{(\theta + C_G) - \gamma P_{1G}}{N - \gamma}, \tag{10}$$

$P_{2BH} = (\theta + C_B)/N$, and $P_{2BL} = (\theta - C_B)/N$.

Proof. In a separating equilibrium, the firm type is known to the market. Since the bad type does not announce, the equilibrium prices for its stock are given by Proposition 1, with C_B replacing C. Since the good type announces, the equilibrium prices for its stock are given by Proposition 2, with C_G replacing C. ■

Figure 3*b* illustrates the price path for each type in a signaling equilibrium in the program-signaling economy. At t_0 good firms announce a program and enjoy positive announcement returns. Bad firms do not announce, and their stock price decreases to reflect their expected value. Postannouncement, the t_0 stock price is higher than in the no-program economy for a good firm, and lower for a bad firm.[20] At t_1, good firms

[20] I acknowledge that there is an implicit commitment here, as in all financial signalling models, that the owners cannot sell their shares at P_0. Otherwise, there is no cost to mimicry.

repurchase if the value realization is high and do not repurchase if the value realization is low. Accordingly, for a good firm, the t_1 stock price is lower than its *expected* value because the market takes the informed trading (the option that the firm has) into account. It will be shown later that under separation the t_1 price is also lower than it would be in the no-program economy. For a bad firm, the t_1 price is equal to its *expected* value (no program therefore no quantity risk), hence, it is lower than the price in the no-program economy. At t_2, for a good firm, in the case of a high realization, the stock price reflects gains from informed trading, hence, is higher than its price would be in the no-program economy. In the case of a low realization, it is the same as in the no-program economy. For a bad firm, the t_2 price is the same as in the no-program economy.

Given separation between good and bad firms, for each type $j \in \{G, B\}$, P_{0j} reflects the expected value of the type's stock. The option to repurchase itself does not generate any value, it only serves the good firms by separating themselves from the bad firms and consequently increasing the expected terminal wealth of their original shareholders in comparison to the no-program economy.

In a separating equilibrium, the terminal wealth of original shareholders of bad firms is not affected by quantity risk because bad firms do not announce. The terminal wealth of original investors of good firms, however, is affected by quantity risk because they do announce. It is easy to show that in comparison to the no-program economy, as a group, original shareholders of a good firm are better off by $(2q-1)(1-p)(C_G - C_B)(K/N)$, and original shareholders of a bad firm are worse off by $(2q-1)p(C_G - C_B)(K/N)$. This happens because the good firms are now able to distinguish themselves from the bad firms. For each type, however, the distribution of wealth between short-term and long-term shareholders is also different. A good firm transfers wealth from short-term shareholders to long-term shareholders (because it announced), whereas a bad firm does not.

How will separation hold? While without a program announcement $P_1 = P_0$, with a program announcement, Proposition 5 implies that under separation, $P_{1G} < P_{0G}$. Under the assumed information process, I will give conditions under which the t_1 decrease in the stock price of the good type generates separation. When these conditions hold, it will pay for good firms to announce a program because bad firms will not mimic.

Proposition 6. *Fix all parameters, including $C_G > C_B > 0$. Then a separating equilibrium exists if and only if $\gamma \in (\gamma_c, K)$, where*

$$\gamma_c = K \frac{1}{1 + \frac{1-q}{2q-1} \frac{N-K}{N}}. \tag{11}$$

Proof. See Appendix A.

It is also shown in the proof of Proposition 6 that the condition $\gamma \in (\gamma_c, K)$ implies $P_{1G} < \theta/N$. Earlier, in the one-firm-type economy, it was demonstrated that if $\gamma \in (\gamma_c, K)$ (i.e., if the program is large enough), the t_1 equilibrium price is decreasing in C (Proposition 3). This happens because, in this range, given a marginal increase in C, the marginal increase in the value of the option to repurchase (the option that the firm is long and the market is short) is larger than the marginal increase in expected stock value. Thus, the higher the C, the lower the price new shareholders are willing to offer. The implication for the two-type economy is that a separating equilibrium exists for all $\gamma \in (\gamma_c, K)$. This is because, in this range, the gap between types in the option value is larger than the gap in expected value, and hence is enough to deter the bad type from mimicking the good type.

In this model, good firms announce not in order to transfer wealth among shareholders (as they maximize the wealth of all original shareholders), or in order to gain from informed trading (as, given the firm type, the informed trading is accounted for by the market), but rather in order to separate themselves from the bad firms (since bad firms cannot afford to mimic). In a separating equilibrium, good firms announce a program at t_0, and their t_1 price reflects informed trading (option value) of a good firm. The loss of a good firm's short-term shareholders from a lower selling price exactly offsets the gain of its long-term shareholders from informed trading. The announcement is, thus, costless for good firms. If a bad firm announces a program, its short-term shareholders will suffer losses that reflect informed trading of a good firm, but its long-term shareholders will only enjoy informed trading gains of a bad firm, which are lower. In other words, if the program size is large enough, good firms can push their t_1 price low enough that, if a bad firm announces, its long-term shareholders will never recover what its short-term shareholders will lose. Because firms maximize the expected aggregate wealth of original shareholders then, for a bad firm the "cost" of this option is higher than its value. Consequently, a bad firm is better off not announcing, and hence a separating equilibrium can hold.[21] In short, in the separating equilibrium, a bad firm does not deviate because it has to pay the same "price" that a good firm pays for the option to repurchase, but it finds the option less valuable because its cash flow is less volatile.

Because the good firm will never announce a program smaller than γ_c, comparative statics on γ_c have empirical implications. It can be observed from Equation (11) that γ_c increases with the probability of the high state

[21] The goal is to demonstrate the existence of a separating equilibrium. It is possible, however, that when a separating equilibrium holds, a pooling equilibrium in which all firms announce also holds.

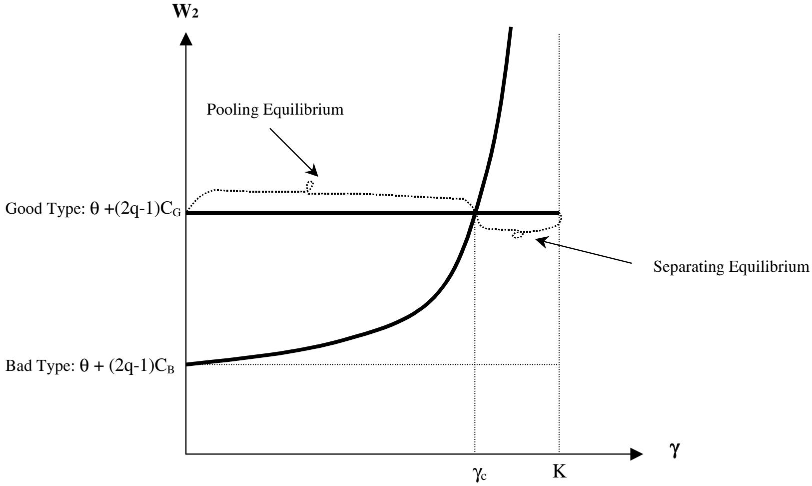

Figure 4
Indifference curves and the single-crossing property
By assumption, $\gamma < K$. The good type has no cost for signaling at any level of γ. Thus its indifference curve is flat. For the bad type, the cost of mimicry is increasing in γ. If $\gamma > \gamma_c$, then the good type announces, the bad type commits not to repurchase by not announcing, and a separating equilibrium exists. If $\gamma < \gamma_c$, then the bad type always mimics, so that a separating equilibrium does not exist.

q and decreases with the liquidity volume K. Although I do not have an interpretation for the former observation (as the parameter q affects both expected value and variance of both good and bad firms), the interpretation of the later observation is that the program size is positively correlated with volume.

Figure 4 demonstrates the single-crossing property. Announcing a program is costless for a good firm regardless of the value of γ, whereas for a bad firm the cost of announcing is strictly increasing in γ. For $\gamma < \gamma_c$, a bad firm is better off when it mimics the good firm. For $\gamma = \gamma_c$, the benefit from mimicry exactly offsets the cost. For $\gamma > \gamma_c$, mimicry results in a net loss and, hence, a separating equilibrium exists.

3. Empirical Implications

This section compares the predictions of the model to the empirical evidence. The model predicts that firms that announce condition actual repurchases on future realization of value. This prediction is consistent with Stephens and Weisbach (1998) findings that firms repurchase either none or practically all of the announced quantity of shares, a substantial number of announcing firms do not repurchase at all, and the expected repurchase level is correlated with the quantity announced.

The model assumes that uncertainty (variance) in the production technology is positively correlated with firm quality (mean) and delivers the result that only good firms announce. This is consistent with Jagannathan, Stephens, and Weisbach (2000) findings that announcing firms have a more volatile cash flow than firms that do not announce, and with Ikenberry and Vermaelen (1996) findings that firms with higher β are more likely to announce. The prediction that the announcement reveals information about the stock volatility can be tested, for example, by looking for changes in the implied volatility from option prices of announcing firms, or alternatively using a GARCH model.

Another prediction is that, postannouncement, expected returns will be relatively low in the short run and relatively high in the long run.[22] In contrast, Ikenberry, Lakonishok, and Vermaelen (1995) find that, post-announcement, firms realize positive abnormal returns regardless of the time horizon. However, they also point out that, postannouncement, the one-year abnormal return in year 3 (4.6%) is significantly higher than in years 1 and 2 (2 and 2.3%, respectively). Because the average program period is one to two years, this evidence is consistent with the model's intuition and the wealth transfer effect.

The model also predicts that, postannouncement, long-run returns will be correlated with the level of actual repurchase. There is supportive evidence in Ikenberry, Lakonishok and Vermaelen (2000), who investigate the postannouncement market performance of Canadian firms.[23] Among announcing firms, they find that, although firms that repurchase perform worse during the repurchase period than firms that do not, in the years following the repurchase period, the situation is reversed with firms that did repurchase during the repurchase period performing better than firms that did not.

While the model suggests that during the repurchase period announcing firms "time" the market, the empirical evidence is inconclusive. Timing ability is hard to investigate, because US firms are under no obligation to disclose when they are trading. However, in a recent article, Cook, Krigman, and Leach (2004) (henceforth "CKL") investigated the timing and execution of open-market programs using voluntarily disclosed data. They found no clear evidence that actual repurchases are timed with information release. In spite of the later findings, it may still be the case that actual repurchases are timed with undervaluation, which is what the model here predicts. Indeed, CKL (2004) also find that many firms

[22] The model assumes that the interest rate is zero and delivers negative short-run returns. With a positive interest rate, the model would deliver the more realistic results of relatively low but positive returns in the short run.

[23] Unlike firms in the United States, Canadian firms must announce their programs, and they are allowed to repurchase only within one year after the announcement.

repurchase following price drops, and Stephens and Weisbach (1998) found that actual repurchases are timed with temporary undervaluation. Both Barclay and Smith (1988) and Brockman and Chung (2001) interpret the bid–ask spread widening they found following repurchase-program announcements as evidence that managers exhibit timing ability. In contrast, CKL (2004) found that the bid–ask spread actually narrows following program announcements.

I am not aware of any evidence that either strengthens or weakens the prediction that the program size is positively correlated with volume (end of Section 2). The model is inconsistent with anecdotal evidence (I am not aware of any systematic inquiry) that some firms start programs without announcing. It is, however, consistent with evidence that some firms announce concurrent with initial repurchases, because outsiders can never predict the actual repurchase pattern within the repurchase period [see CKL (2004)].

In the model presented here, there is no relation between the program size and the announcement return (see Figure 3*b*). This result is consistent with the findings of Stephens and Weisbach (1998, Table 3). Earlier studies, however, find a positive relation [Ikenberry Lakonishok, and Vermaelen (1995), Ikenberry and Vermaelen (1996)]. The model's main prediction with respect to program size is that it is (weakly) negatively correlated with the depth of the market. This is because γ_c decreases with K. I am not aware of any study that investigates this relation.

4. Robustness and Further Research

The single-firm-type version of this model suggests that the option a firm grants itself by announcing a repurchase program does not, by itself (i.e., without heterogeneity in types), generate announcement returns. The informed trading associated with this option can, however, transfer wealth from short-term shareholders to long-term shareholders. Based on this effect, I constructed a signaling (two-type) model that can deliver positive announcement returns, even though the announcement does not constitute a commitment. Unlike most signaling models, in the present model, announcing (good) firms do not incur any cost. I suggest that this is precisely what makes repurchase programs so popular.

The model does, however, have limitations. The results depend crucially on the assumptions that liquidity constraints are severe, and that variance is positively correlated with expected return (in the production technology) across types.[24] The model also abstracts from the cost of paying out

[24] Whether risk is correlated with return in the production technology, as this model assumes, is an empirical question. Projects in new technologies fit well here. The model results would not hold if the

the cash,[25] and, as discussed in the previous section, not all the model predictions fit the empirical evidence. Still, it points to some of the effects brought about by the announcement of repurchase programs that may offer a modest contribution to the understanding of repurchase programs.

The rest of this discussion suggests directions for further research. In general, any situation in which the transfer of wealth from short-term to long-term shareholders is in the interest of a firm justifies the use of a repurchase program, but either a signaling or a value-creation motivation must be associated with this wealth transfer in order to explain the positive announcement return. The wealth transfer effect raises an open question in corporate finance. Whose value is the firm maximizing? The value of all original shareholders, or only the value of long-term shareholders?[26] If a firm's quality (type) is correlated with the weight that managers assign to the wealth of long-term shareholders versus short-term shareholders in their objective function [in the spirit of Miller and Rock (1985)], then repurchase programs can deliver announcement returns even if the assumption that expected return is correlated with variance across types is relaxed.[27] Section 1 demonstrated that a program announcement is associated not only with a transfer of wealth among shareholder groups, but also with a generation of risk to these groups. When agents are risk averse, this is an undesirable property that may affect a firm's payout policy.

In this model and in the extensions suggested above, the *actual* repurchase in a repurchase program has no signaling or social-value-creating role. It is possible that the announcement of a repurchase program is an informal commitment on the firm's part to later repurchase, conditional on the realization of some market/firm variables. If so, then repurchase programs might have an advantage over other payout methods (dividends, tender offers) that cannot be conditioned in the first place because they are executed immediately. On the other hand, reputation effects might provide an alternative explanation for an announcement return without a formal commitment to repurchase.

In a recent article, Bhattacharya and Dittmar (2003) also suggested that open-market programs are costless signals. In their model, the program announcement is cheap talk used by good firms to attract scrutiny. A bad

correlation is negative. However, assuming managers maximize shareholders' wealth, all negative NPV projects can be excluded. So if, for example, the relation is U-shaped in the risk–return space, the results would still hold.

[25] Paying out the cash, however, may create value [see Jensen (1986), and Chowdhry and Nanda (1994)].

[26] See Myers and Majluf (1984) and Dybvig and Zender (1991). Most of the literature distinguishes between existing shareholders, who hold their investment until the end, and other shareholders, whereas the present model distinguishes between types of existing shareholders (short-term versus long-term).

[27] Firms that favor the long-term shareholders may be of higher quality, for example, because their managers focus on overall performance rather than only on short-term performance.

firm will not mimic, because it will not gain from being discovered. Bhattacharya and Dittmar (2003) provide evidence consistent with their model predictions.

Appendix B considers an extension with informed competitors to the firm. The analysis there suggests that the presence of informed competitors may motivate a program announcement in order to prevent value leakage from shareholders to these competitors, rather than in order to signal types. However, if these informed competitors are employees, and if the firm favors employees over other shareholders, it will be in favor of such value leakage, in which case the firm will have no motivation to announce.

Appendix A: Proofs

Proof of Proposition 1. In all proofs, equilibrium bids and strategies are indicated with *. I solve backwards for the equilibrium prices. At t_2, all information is public and there are N shares outstanding, so that $P_{2H} = (\theta + C)/N$ and $P_{2L} = (\theta - C)/N$. Note that for $t < 2$

$$E[P_2] = (\theta + (2q-1)C)/N = V_0/N. \tag{12}$$

At t_1, the firm does not participate, and Bertrand competition among outside investors implies that the expected profit for outside investors equals zero. That is,

$$E[((P_2 - P_1(d^*))\Psi_{mi}(d^*))] = 0 \quad \text{for all } m \in \{1, \ldots, M\} \tag{13}$$

where $i \in \{L, H\}$. Since mixing is not allowed, and d^* (hence P_1) is independent of the realization of $\tilde{c}$, we can use Equation (12) to rewrite Equation (13) as

$$(V_0/N - P_1(d^*))\Psi_{mi}(d^*) = 0 \quad \text{for all } m \in \{1, \ldots, M\} \tag{14}$$

where $i \in \{L, H\}$. The market mechanism dictates that $P_1(d) = b_{\max}$ where $b_{\max} \equiv \max \{b_m \in b\}$. Thus, in any Nash Equilibrium, $P_1(d^*) = b^*_{\max} = V_0/N$. (The equilibrium strategy profile d^* is not unique, however.)

At t_0, original shareholders expect to get $P_1 = V_0/N$ for each stock with certainty at t_1 if they become constrained; from Equation (12) they expect to get $E[P_2] = V_0/N$ at t_2 if they do not become constrained. Thus, at t_0, they are willing to pay $P_0 = V_0/N$ for each stock. ■

Proof of Proposition 2. At t_2, all information is public. Thus, P_2 reflects the true value, which in turn depends on P_1, on the realization of $\tilde{c}$, and on the number of shares repurchased, $\Psi_{fi}(d)$, where $i \in \{L, H\}$. Specifically,

$$P_{2H}(d) = \frac{(\theta + C) - \Psi_{fH}(d)P_1}{N - \Psi_{fH}(d)}, \qquad P_{2L}(d) = \frac{(\theta - C) - \Psi_{fL}(d)P_1}{N - \Psi_{fL}(d)}. \tag{15}$$

Next, going back to t_1, I derive P_1 by imposing constraints on the equilibrium strategy profile d^*. Bertrand competition among outside investors implies that the expected profit for outside investors equals zero; that is, for all $m \in \{1, \ldots, M\}$, the equilibrium strategy profile d^* must satisfy

$$\begin{aligned} E[((P_2(d^*) - P_1(d^*))\Psi_{mi}(d^*))] &= q[P_{2H}(d^*) - P_1(d^*)]\Psi_{mH}(d^*) \\ &\quad + (1-q)[P_{2L}(d^*) - P_1(d^*)]\Psi_{mL}(d^*) \\ &= 0. \end{aligned} \tag{16}$$

The firm gets to observe the realization of $\tilde{c}$ at t_1, hence d^* must also satisfy the following conditions:

$$(P_{2H}(d^*) - P_1(d^*))\Psi_{fH}(d^*) \geq 0, \tag{17}$$

$$(P_{2L}(d^*) - P_1(d^*))\Psi_{fL}(d^*) \geq 0. \tag{18}$$

The auction mechanism dictates that $P_1(d) = b_{\max}$, where $b_{\max} \equiv \max\ \{b_m \in b\}$. Thus, in any equilibrium, $(\theta - C)/N < b_{\max} < (\theta + C)/N$ (otherwise, Equation (15) implies that Equation (16) is violated, regardless of what the firm bids.) Because the firm observes the realization, its best response is $b_{fH} > b_{\max}$ and $b_{fL} < b_{\max}$. Accordingly, the allocation rule dictates that the equilibrium strategy profile d^* must satisfy

$$\Psi_{fL}(d^*) = 0; \quad \Psi_{fH}(d^*) = \gamma. \tag{19}$$

That is, the firm always gets γ shares in the case of a high realization and gets 0 shares in the case of a low realization. The above restrictions are sufficient for deriving the equilibrium price. Rewrite Equation (15) as

$$P_{2L}(d^*) = \frac{(\theta - C)}{N}, \qquad P_{2H}(d^*) = \frac{(\theta + C) - \gamma P_1}{N - \gamma}. \tag{20}$$

Since $P_1 = b_{\max}$, where $b_{\max} \equiv \max\ \{b_m \in b\}$, substitute (20) into (16) to get

$$q\left[\frac{(\theta + C) - \gamma P_1}{N - \gamma} - P_1\right]\Psi_{\max H}(d^*) + (1 - q)\left[\frac{(\theta - C)}{N} - P_1\right]\Psi_{\max L}(d^*) = 0, \tag{21}$$

where $\Psi_{\max i}$ is the allocation for each outside bidder who submits $b_{\max}$ given $i \in \{L, H\}$. Now, given there are S bidders at $b_{\max}$, Equation (19) dictates that

$$\Psi_{\max H}(d^*) = (K - \gamma)/S; \quad \Psi_{\max L}(d^*) = K/S. \tag{22}$$

Substituting Equation (22) into Equation (21), the equilibrium price P_1 must satisfy

$$q\left[\frac{(\theta + C) - \gamma P_1}{N - \gamma} - P_1\right](K - \gamma) + (1 - q)\left[\frac{(\theta - C)}{N} - P_1\right]K = 0. \tag{23}$$

Note that S cancels out when constructing Equation (23). Solve Equation (23) for P_1 to get Equation (6).

At t_0, original shareholders know they will get P_1 for each stock with certainty at t_1 if they become constrained; they expect to get $E[P_2]$ for each stock at t_2 if they do not become constrained. Thus, at t_0, for each stock, they are willing to pay

$$P_0 = (K/N)P_1 + ((N - K)/N)E[P_2]. \tag{24}$$

$E[P_2]$ can be computed from Equation (20) to be

$$E[P_2] = q\frac{(\theta + C) - \gamma P_1}{N - \gamma} + (1 - q)\frac{(\theta - C)}{N}. \tag{25}$$

Use Equations (6) and (25) to show that Equation (24) simplifies to

$$P_0 = (\theta + (2q - 1)C)/N, \tag{26}$$

which is equal to P_0 in the case without a program announcement. Using Equation (20), it can be verified that P_{2L} is the same with or without a program and that P_{2H} is higher with a program than without a program (by substituting $P_1 = b_{\max} < (\theta + C)/N$.) Consequently, $E[P_2]$ is higher with a program. Hence, Equation (24) implies that P_1 must be lower with a program than without one. Since without a program $P_1 = P_0$, then it must be the case that with a program $P_1 < P_0$. ■

Proof of Proposition 3. Apply the implicit function theorem on Equation (23) and use $P_1 < (\theta + C)/N$ to show that P_1 is decreasing in γ. Differentiate Equation (6) to show that P_1 is increasing in K. Apply the implicit function theorem on Equation (23) and use $P_1 < (\theta + C)/N$ to show that P_1 is increasing in q. Last, differentiate Equation (6) with respect to C to show that if $\gamma > \gamma_c$, where γ_c is given in Equation (8), then P_1 is decreasing in C, otherwise, P_1 is increasing in C. ■

Proof of Proposition 6. Under separation, from Proposition 5, $P_{0B} = P_{1B} = (\theta + (2q-1)C_B)/N$. Also $P_{2BH} = (\theta + C_B)/N$ and $P_{2BL} = (\theta - C_B)/N$. Consider a bad firm that deviates and announces a repurchase. At t_1, short-term shareholders get paid P_{1G}, given in Equation (9) for each share they sell, instead of $(\theta + (2q-1)C_B)/N$. At t_2, all information is public. When the value realization is low, the bad firm's long-term shareholders get paid $(\theta - C_B)/N$ for each stock they own if the firm did not repurchase, and they get paid $\frac{\theta - C_B - \gamma P_{1G}}{N-\gamma}$ if it did repurchase. When the value realization is high, the bad firm's long-term shareholders get $(\theta + C_B)/N$ for each stock they own if the firm did not repurchase, and they get paid $\frac{\theta + C_B - \gamma P_{1G}}{N-\gamma}$ if it did repurchase. Let

$$\delta(\gamma) = \frac{(2q-1) - q\frac{N-K}{K}\frac{\gamma}{N-\gamma}}{1 - q\frac{N-K}{K}\frac{\gamma}{N-\gamma}}. \tag{27}$$

$\delta(\gamma)$ is strictly *decreasing* in γ, and maps $\gamma \in (0, K)$ into $\delta \in (-1, (2q-1))$, where $\delta(\gamma = \gamma_c) = 0$. Rewrite Equation (9) using Equation (27) as

$$P_{1G} = (\theta + \delta C_G)/N. \tag{28}$$

Note that P_{1G} is increasing in δ, consistent with the result from Proposition 3 that P_{1G} is decreasing in γ. Next, we derive the conditions under which a bad firm will not deviate. There are four cases to consider:

1. Suppose $P_{1G} > (\theta + C_B)/N$. If a bad firm deviates and announces at t_0, its short-term shareholders are better off because $P_{1G} > (\theta + (2q-1)C_B)/N$. The bad firm will never buy shares (because its share value is always lower than P_{1G}), so that its long-term shareholders will get the same as what they would get without an announcement. Since the firm is maximizing the expected wealth of all original shareholders, it will always deviate and announce.
2. Suppose $(\theta + (2q-1)C_B)/N < P_{1G} < (\theta + C_B)/N$. If a bad firm deviates at t_0 and announces, short-term shareholders are better off by $P_{1G} - (\theta + (2q-1)C_B)/N$. In case of a high realization, the deviating firm will buy shares and make a profit of $\gamma[(\theta + C_B)/N - P_{1G}]$ per share, which will accrue to all shareholders selling at t_2, not just to the original long-term shareholders. In case of a low realization, the bad firm will not repurchase and the wealth of original long-term shareholders will not be affected. Hence the bad firm will deviate.
3. Suppose $(\theta - C_B)/N < P_{1G} < (\theta + (2q-1)C_B)/N$, and note that [using Equation (28)] this is the range $-\frac{C_B}{C_G} < \delta < (2q-1)\frac{C_B}{C_G}$. Consider a bad firm that deviates at t_0 and announces. Its short-term shareholders are worse off by $(\theta + (2q-1)C_B)/N - P_{1G}$. If the value realization is low, the value of the bad firm's stock is $(\theta - C_B)/N$, and the bad firm will not repurchase because in this range $P_{1G} > (\theta - C_B)/N$. If the value realization is high then the value of a bad firm's stock is $(\theta + C_B)/N$ per share so that the firm will repurchase. This happens only with probability q. Of this gain, long-term shareholders will only get

$$\frac{N-K}{N-\gamma}\gamma[(\theta + C_B)/N - P_{1G}]. \tag{29}$$

   The rest of the gain will accrue to new shareholders buying at t_1. Thus, in this case, the separation condition is that what the short-term shareholders lose, $K[(\theta + (2q-1)C_B)/N - P_{1G}]$, should be more than what the long-term shareholders gain from a repurchase if realization is high. The later gain is given in Equation (29). That is, the separation condition is

$$q\frac{N-K}{N-\gamma}\gamma[(\theta+C_B)/N-P_{1G}]<K[(\theta+(2q-1)C_B)/N-P_{1G}]. \tag{30}$$

Rearrange Equation (30) using Equations (9) and (27) to give

$$0<\delta(C_B-C_G), \tag{31}$$

which in turn requires that $\delta<0$, and which is equivalent to

$$\gamma>\gamma_c=K\frac{1}{1+\frac{1-q}{2q-1}\frac{N-K}{K}}. \tag{32}$$

4. It can be shown that separation holds also in the range $(\theta-C_G)/N<P_{1G}<(\theta-C_B)/N$, which corresponds to $-1<\delta<-\frac{C_B}{C_G}$. Intuitively, although in this range the deviating firm will buy shares also upon low realization, as P_{1G} decreases to levels lower than $(\theta-C_B)/N$ (that is, when $\delta<-\frac{C_B}{C_G}$), the marginal loss of the short-term shareholders is higher than the marginal gain of the long term shareholders.

Last, it is immediate to show that a good firm will not mimic a bad firm either. Intuitively, by assumption, firms that do not announce are not allowed to repurchase. Hence, if a good firm deviates, its long-term shareholders lose more than what its short-term shareholders gain. To conclude, the separating condition is $\delta\in(-1,0)$, which is equivalent to $\gamma\in(\gamma_c,K)$ and, using Equation (28), results in $P_{1G}<\theta N$. ■

Appendix B: Extension — Competitors to the Firm

I will first consider the single-type framework. Suppose that at the time the firm observes the value realized, some of the outside bidders also observe it. If such "informed competitors" to the firm exist, they will compete with each other and with the firm, and the equilibrium will be revealing. However, if informed competitors can bid only for small quantities with a total of some ε in the sense that $\gamma+\varepsilon<K$ (say, because of the risk of lawsuits), then the equilibrium will not be revealing, and these informed competitors will have trading gains alongside the firm. In this case, if the market is not aware of their presence (as they do not "announce"), their trading gains will be at the expense of the new shareholders. Otherwise (if the market expects informed competitors) their trading gains will be at the expense of the short-term investors, since P_1 will be lower. If indeed the market is aware of these informed competitors, then P_1 is affected whether the firm announces or not. (It is like $\gamma=\gamma+\varepsilon$ if the firm announces, and $\gamma=\varepsilon$ otherwise.) Assuming that at t_0 these competitors do not have superior information, P_0 will not be affected.

Suppose that the market is aware of the presence of informed competitors, that informed competitors bid for $\varepsilon<K$, and that the firm can announce a program such that $\gamma<K<\gamma+\varepsilon$. Then, without a program, the informed outsiders are making profit at the expense of the liquidity traders; whereas, with a program, the firm repurchases at true value in the high state (alongside the informed outsiders), and the newcomers purchase at true value in the low state. The equilibrium is revealing and the leakage to outsiders is stopped. Simply put, the presence of competitors to the firm might motivate a program announcement in order to stop value leakage from the shareholders to informed competitors (by revealing new information to the market through trade), rather than in order to signal types. However, if these informed competitors are employees, and if the firm favors employees over other shareholders, it will be in favor of such value leakage and will have no motivation to announce.

In the two-type version, if $\gamma+\varepsilon<K$, the separation result still holds, but not if $\gamma+\varepsilon>K$ (since in the later case the equilibrium is revealing.)

References

Barclay, M., and C. Smith, 1988, "Corporate Payout Policy: Cash Dividends versus Open-Market Repurchases," *Journal of Financial Economics*, 22, 61–82.

Bhattacharya, S., 1979, "Imperfect Information, Dividend Policy, and 'the Bird in Hand' Fallacy," *Bell Journal of Economics*, 10(1), 259–270.

Bhattacharya, S., 1980, "Nondissipative Signaling Structures and Dividend Policy," *Quarterly Journal of Economics*, 95, 1–24.

Bhattacharya, U., and A. Dittmar, 2003, "Costless versus Costly Signaling: Theory and Evidence," working paper, MIT and University of Michigan.

Brennan, M., and A. Kraus, 1987, "Efficient Financing under Asymmetric Information," *Journal of Finance*, 42, 1225–1243.

Brennan, M., and A. Thakor, 1990, "Shareholder Preferences and Dividend Policy," *Journal of Finance*, 45, 993–1018.

Brockman, P., and D. Chung, 2001, "Managerial Timing and Corporate Liquidity: Evidence from Actual Share Repurchases," *Journal of Financial Economics*, 61, 417–448.

Chowdhry, B., and V. Nanda, 1994, "Repurchase Premia as a Reason for Dividends: A Dynamic Model of Corporate Payout Policies," *The Review of Financial Studies*, 7, 321–350.

Comment, R., and G. Jarrell, 1991, "The Relative Signaling Power of Dutch-Auction and Fixed-Price Self-Tender Offers and Open-Market Share Repurchases," *Journal of Finance*, 46, 1243–1271.

Cook, D., L. Krigman, and J. Leach, 2004, "On the Timing and Execution of Open-Market Repurchases," *Review of Financial Studies*, 17, 463–498.

Daniel, K., and S. Titman, 1995, "Financing Investment under Asymmetric Information," in R. Jarrow, V. Maksimovic, and W. Ziemba (eds.), *Handbooks in Operations Research and Management Science*, vol. 9, 721–766, Elsevier Science B.V., Amsterdam, The Netherlands.

Dybvig, P., and J. Zender, 1991, "Capital Structure and Dividend Irrelevance with Asymmetric Information," *Review of Financial Studies*, 4, 201–219.

Glosten, L., and P. Milgrom, 1985, "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders," *Journal of Financial Economics*, 14, 71–100.

Grullon, G., and R. Michaely, 2002, "Dividends, Share Repurchases, and the Substitution Hypothesis," *Journal of Finance*, 57, 1649–1684.

Heinkel, R., 1982 "A Theory of Capital Structure Relevance under Imperfect Information," *Journal of Finance*, 37, 1141–1150.

Ikenberry, D., J. Lakonishok, and T. Vermaelen, 1995, "Market Underreaction to Open-Market Stock Repurchases," *Journal of Financial Economics*, 39, 181–208.

Ikenberry, D., J. Lakonishok, and T. Vermaelen, 2000, "Stock Repurchases in Canada: Performance and Strategic Trading," *Journal of Finance*, 55, 2373–2397.

Ikenberry, D., and T. Vermaelen, 1996, "The Option to Repurchase Stock," *Financial Management*, 25, 9–24.

Jagannathan, M., C. Stephens, and M. Weisbach, 2000, "Financial Flexibility and the Choice between Dividends and Stock Repurchases," *Journal of Financial Economics*, 57, 355–384.

Jensen, M., 1986, "Agency Costs of Free Cash Flow, Corporate Finance, and Take Overs," *American Economic Review*, 76, 323–329.

John, K., and J. Williams, 1985, "Dividends, Dilution and Taxes: A Signaling Equilibrium," *Journal of Finance*, 40(4), 1053–1070.

Johnson, C., and J. McLaughlin, 1997, *Corporate Finance & the Securities Laws*, Aspen Publishers, New York, NY, chap. 13.

Kyle, A., 1989, "Informed Speculation with Imperfect Competition," *The Review of Economic Studies*, 56, 317–356.

Miller, M., and F. Modigliani, 1961, "Dividend Policy, Growth, and the Valuation of Shares," *Journal of Business*, 34, 411–433.

Miller, M., and K. Rock, 1985, "Dividend Policy, under Asymmetric Information," *Journal of Finance*, 40, 1031–1051.

Myers, S., and N. Majluf, 1984, "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have," *Journal of Financial Economics*, 13, 187–221.

Netter, J., and M. Mitchell, 1989 "Stock-Repurchase Announcements and Insider Transactions after the October 1987 Stock Market Crash," *Financial Management*, 18, 84–96.

Noe, T., 2002, "Investor Activism and Financial Market Structure," *Review of Financial Studies*, 15, 289–318.

Ofer, R., and A. Thakor, 1987, "A Theory of Stock Price Responses to Alternative Corporate Cash Disbursement Methods: Stock Repurchases and Dividends," *Journal of Finance*, 42, 365–394.

Persons, J., 1994, "Signaling and Takeover Deterrence with Stock Repurchases: Dutch Auctions versus Fixed Price Tender Offers," *Journal of Finance*, 49, 1373–1402.

Rock, K., 1986, "Why New Issues Are Underpriced," *Journal of Financial Economics*, 15, 187–212.

Ross, S., 1977, "The Determination of Financial Structure: The Incentive Signaling Approach," *The Bell Journal of Economics*, 8, 23–40.

Stephens, C., and M. Weisbach 1998, "Actual Share Reacquisition in Open-Market Repurchase Programs," *Journal of Finance*, 53, 313–333.

Vermaelen, T., 1981, "Common Stock Repurchase and Market Signaling: An Empirical Study," *Journal of Financial Economics*, 9, 139–183.