Payout Policy, Financial Flexibility, and Agency Costs of Free Cash Flow *

Jacob Oded †

This Draft: September 21, 2018

Abstract

We consider the informed trade associated with open-market repurchase programs, the prevailing method that firms use to disburse cash today. We show that when agency costs of free cash are an issue, personal gains to informed insiders associated with the firms' repurchase trade can stimulate free cash disbursement. Thus, though the informed shareholders make trading gains at the expense of the uninformed shareholders, the uninformed shareholders gain benefits of free cash waste prevention, which are higher than their trading losses. Unlike the case of dividend payout, the execution of open-market programs is optional, and hence they cannot completely prevent the waste of free cash. Relative to dividends, however, open-market programs avoid underinvestment by leaving insiders the option to cancel the payout when the firm is cash constrained. We demonstrate the implications of this result on a firm's choice between dividends and repurchases. The model provides testable predictions that are generally consistent with the empirical evidence.

JEL Classifications: G14, G30, G35

Keywords: payout policy; stock repurchases; dividends; informed trade; agency costs of free cash

*I would like to thank Ilona Babanko, Avraham Beja, Simon Benninga, Kobi Boudoukh, Ilan Cooper, Eugene Kandel, Nisan Langberg, Yaron Leitner, Roni Michaely, Allen Michel, Amiyatosh Purnanandam, Yuri Tserlukevich, Avi Wohl, and seminar participants at Boston University, Hebrew University, IDC Herzliya, Tel Aviv University, University of Haifa, University of Houston, University of Mannheim, and at the FIRS and WFA meetings. All remaining errors are my own. Financial support from the Israeli Science Foundation, Teva Pharmaceuticals, and The Henry Crown Institute of Business Research is gratefully acknowledged.

†Coller School of Management, Tel Aviv University, Tel Aviv, 69978, Israel. Tel: 972-3640-6301 Email: oded@post.tau.ac.il

1 Introduction

Payout policy during the 1980's and the 1990's was characterized by dramatic growth in repurchase activity and a decrease in firms' tendency to pay dividends.[1] Since the late 1990's, however, dividends and repurchases have had similar economic significance, indicating both payout methods remain important (see for example Farre-Mensa, Michaely and Schmalz 2014). Extensive theoretical work has considered how firms choose between dividends and repurchases. The vast majority of this literature uses taxes or a signaling framework. Interestingly, agency theories of free cash are standard in the capital-structure literature but are rather rare in the payout literature. We aim to fill this gap.

Empirically, problems associated with the disbursement of free cash through repurchases are well documented. Many repurchase program announcing firms eventually repurchase only part of what they announce, if at all (e.g. Stephens and Weisbach 1998), suggesting repurchases are not that efficient in paying out free cash. Repurchases also redistribute wealth among the shareholders whenever the stock is mispriced (e.g. Barclay and Smith 1988, and Brennan and Thakor 1990). Dividends are less subject to these drawbacks as they are relatively more committing and because they are pro-rata. Dividends' stronger commitment to payout comes at a cost, as it leaves management less freedom to adjust payout to investment needs. Although firms can raise cash to compensate for the non-flexible nature of dividends, issue costs tend to be high (e.g., Ross, Westerfield and Jordan 2008). Indeed, the importance of financial flexibility in payout policy is well documented (e.g. Brav, Graham, Harvey and Michealy 2005, Lee and Rui 2007, and Bonaime, Hankins and Harford 2011).

In this paper we consider payout policy as a trade-off between preserving financial flexibility and preventing the waste of free cash, under asymmetric information. Forcing payout of cash can constrain the firm and result in underinvestment, while not forcing payout may result in overinvestment/free-cash-waste by self-interested managers. The shareholders' problem is thus how to get managers (insiders) to return cash to shareholders without hurting investment, when only the insiders get to see whether this cash is free or not. To deal with this problem, the shareholders have several alternatives. They can choose not to pay out any cash. In this case they accept the agency problem, but make it less likely that investment will be shaved. Indeed, many firms do not pay out cash. These are usually growth firms for which financial flexibility is crucial and agency costs of free cash are low. If they do want to disburse free cash, the shareholders can choose to pay dividends. We view dividends as a predetermined

[1] On the growth in repurchase during the 1980s-1990s, see, for example, Grullon and Michaely (2002), and Boudoukh, Michaely, Richardson and Roberts (2007). On the decrease in tendency to pay out dividends, see, for example, DeAngelo, DeAngelo and Skinner (2004).

payout program, since they become a commitment once declared by the board, and also informally commit the firm to future dividends. Another option available to the shareholders is to announce an open-market stock repurchase program (henceforth "open-market program" or "repurchase program" or "repurchase"), which we view as a (costly) payout-incentivizing mechanism. Specifically, because an open-market program does not commit the firm to repurchase any shares, it leaves the management (insiders) the option not to pay out the cash if the cash is later needed for operations. On the other hand, it can incentivize payout when cash is not needed for operations by providing these better informed insiders with gains through the firm's informed repurchase trade that may outweigh their benefit from wasting free cash. The general shareholders lose from the adverse selection that the insiders' informed trade engenders, but at the same time they benefit from preserving the firm's financial flexibility and alleviating the problem of wasting of free cash.

We develop a model of payout policy to support these arguments. In a two-period setup, the model considers a financially constrained firm that faces uncertainty about its investment needs. The firm is owned by general shareholders (outsiders) and is run on their behalf by agents (insiders). These agents are shareholders too, but they also gain private benefits from the waste of free cash. The outside shareholders dictate the firm's payout policy (e.g. through its board, shareholder meetings, and relationship investing) and choose among a dividend, a repurchase program, and no payout in order to maximize their wealth. A dividend forces cash out of the firm immediately and thereby prevents the waste of free cash, but may result in shaving of investment in the case where the investment opportunity turns out to be large. A repurchase program announcement delegates the decision whether or not to pay out cash to the insiders. Given a repurchase program announcement, if the investment opportunity is realized to be large, the firm has no free cash, and hence the insiders will not execute the program. If the investment opportunity is realized to be small, the firm has free cash that the insiders may waste if the stock is overvalued but will use to execute the repurchase through the financial markets if the stock is undervalued. Thus, while their informed trades on the firm's behalf benefit the insiders at the expense of the (uninformed) outside shareholders, the outside shareholders also benefit from preventing a waste of cash. The payout policy set by outside shareholders is determined as an optimization (minimization) of investment shaving, trading losses to the insiders, and free cash waste.

The analysis emphasizes two important properties of open-market programs that dividends do not share and that may explain the role of these programs as a payout tool. First, the model builds and crucially depends on the assumption that open-market programs are flexible while dividends are committed. That is, it assumes there is an option not to repurchase, should the availability of free cash change while dividends must be paid once declared. This assumption has strong support in the corporate world. Legally, the announcement of a program does not commit the firm to repurchase any shares, while a dividend declaration is a firm commitment. There is also vast empirical evidence that firms only partly execute their announced repurchase programs, if at all. Indeed, Netter and Mitchell (1989) report that immediately after the market crash in October 1987, hundreds of companies announced a repurchase program, but many of them did not repurchase any shares. Stephens and Weisbach (1998) find that in the US 5% of announced programs are not executed at all, and that average actual repurchase rates are only 70–80%. Outside the US actual repurchase rates are even lower. Ikenberry Lakonishok and Vermaelen, (2000) find average actual repurchase rates to be as low as 28% in Canada, Rau and Vermaelen (2002) find average actual repurchase rates of only 37% in the United Kingdom, and Ginglinger and Hamon (2007) find only 10% in France. In their CFO survey, Brav et al. (2005) find that it is not unusual for firms to announce that they will repurchase shares whenever the stock is undervalued, and they often state that the repurchase program may be suspended or discontinued at any time without prior notice.

At the same time there is strong empirical evidence that dividends are NOT flexible, and that firms smooth and are reluctant to reduce or omit dividends. Lintner (1956) and Brav et al. (2005) find that managers consider maintaining stable dividends a top priority and would pass on positive NPV investment before cutting dividends. Leary and Michaely (2011) find that the firms that smooth dividends the most are those most likely to be subject to agency costs of free cash flow, consistent with the link between agency conflicts and inflexibility of dividends that our model builds on. Other studies find that firms only omit dividends in the face of persistently anemic earnings (e.g. Miller and Modigliani 1961, Healy and Palepu 1988, and Michaely, Thaler and Womack 1995). Dividend reductions are relatively rare (e.g., DeAngelo, DeAngelo and Skinner 2000) and stock market penalties for such reductions are well documented (e.g., Aharony and Swary 1980, Healy and Palepu 1988). There are no such penalties documented for repurchases (see Stephens and Weisbach 1998). Indeed, industry trends suggest that modern corporations face an increasing need for agility that dividends lack and open-market programs provide. This is generally the case for hi-tech firms because of their need for financial flexibility. For example, when Microsoft started to pay out cash, excluding a one-time special dividend, the payout was designed to be executed primarily through a four-year open-market repurchase program rather than through dividends. Other maturing tech giants have followed this pattern (e.g. Intel, Microsft, and Apple).

Second, the model results suggest that open-market programs stimulate the payout of free cash by providing gains to insiders through the firm's informed trade. Repurchases may stimulate payout when outside shareholders who worry about free cash waste are not powerful enough to impose payout in the form of dividends on insiders. Indeed, firms often respond to shareholder activists' demand for dividends with a willingness to initiate share repurchase programs (e.g. Kirk Kerkorian with Chrysler and Carl Ichan with Time Warner). Given the increasing cash holdings of corporations and the declining propensity of firms to pay dividends, our findings suggest that open-market programs may have evolved as a mechanism that motivates payout when dividends would constrain the firm, or are hard to impose on self-interested insiders.[2]

While informed trade has several positive externalities, from more efficient price formation to better resource allocation, the repurchase literature, has generally focused on the wealth transfer associated with it that adversely affects uninformed investors (e.g. Barclay and Smith 1988, Brennan and Thakor 1990, Hao 2016). Our novel contribution is in showing how this informed trade from the firm side can also benefit the uninformed, and in demonstrating the manner in which this feature may shape the firm's choice between dividends and repurchase. Specifically, we suggest repurchases' wealth redistribution property can serve as an incentive to disburse cash exactly when the cash is not needed for investment (when the cash is free), and is more likely to otherwise be wasted. More generally, the wealth redistribution property can help align the actions of the agent (insiders) with the interests of the general shareholders. That is, we suggest that the wealth redistribution does not represent a zero-sum game. In the presence of agency costs of free cash and financial constraints, the repurchase trade does not merely transfer wealth from outsiders to insiders; it can also enhance social wealth. We then demonstrate the implications on a firm's choice between dividends and repurchases.

The analysis also highlights two limitations of repurchase programs. First, for repurchases to work as a payout mechanism, they cannot signal poor investment prospects (bad news). If they did, they would result in market selloffs. For repurchases not to signal bad news, the firm must repurchase not only based on availability of free cash but rather strategically, based also on mispricing. Second, because repurchase programs are executed strategically, they cannot completely prevent the waste of free cash. Hence, they provide only a partial solution to the waste of free cash problem. This limitation is consistent with the aforementioned empirical evidence that actual repurchase rates are low.

The model's main empirical prediction is that mature firms have high payouts and tend to disburse cash using dividends rather than repurchases; while growth firms are less likely to pay out cash, but if they do, they use repurchases rather than dividends. This is because for mature firms the expected benefits of preventing the waste of free cash are higher than

[2] Cash holdings of US companies reached \$1.9 trillion in 2016, up from \$0.74 trillion in 2006. (See, *S&P Global* May 25, 2017, "U.S. corporate cash reaches \$1.9 trillion but rising debt and tax reform pose risk·") On the importance of optimizing the firm's cash holdings see, for example, Almeida, Campello and Weisbach (2004).

the costs of investment shavings; for growth firms, the situation is reversed. This prediction is broadly consistent with the empirical evidence. Another prediction is that firms that are likely to realize large amounts of *free* cash will tend to pay out cash using dividends more than repurchases. This is because the more available free cash, the higher the loss when it is wasted. Dividends do a better job than repurchases in disbursing free cash so they will be the preferred payout method when the waste of free cash problem is likely to be severe.

The model also generates several other testable predictions. It predicts that risky firms, (firms with high variability of return on investment) are more likely to repurchase than pay dividends, while the opposite is true for safe firms. This is because the incentive to repurchase is provided through gains from adverse selection for which uncertainty (risk) about future returns is necessary. No such variability is needed for dividend payouts. In contrast, uncertainty of free cash resulting from uncertainty in investment needs (as opposed to uncertainty in return on investment) will be associated with dividends more than with repurchase, because, for the insiders, it increases the benefit from waste more than it increases the incentive to repurchase for trading gains. Hence, another new prediction of our model is that higher variability in investment needs/opportunities will be associated more with dividend than repurchase.

The model also offers new predictions about the manner in which insider ownership and governance quality affect payout policy. Higher insider ownership makes repurchases more likely than dividends because it increases the insiders' share in waste prevention gains while their benefits from the waste of cash do not depend on their ownership. Similarly, better governance also makes repurchases more likely than dividends because it is associated with lower benefits to insiders from waste and hence gives a greater incentive to repurchase.

2 Related literature

Most of the theoretical literature about payout policy focuses on the importance of taxes and on signaling motivation. The tax-based literature suggests that payout policy matters because payouts trigger a tax liability. Dividends are tax-disadvantageous compared to repurchases (e.g., Black 1976, and Gottesman and Jacoby 2006). As tax rates on dividends and repurchases have been reduced over the years, the relative importance of other motivations has increased. The signaling literature suggests that good firms initiate and increase dividends or stock buybacks in order to distinguish themselves from bad firms (e.g., Ofer and Thakor 1987, McNally 1999, Babenko, Tserlukevich and Vedrashko 2012, and Bond and Zhong 2016). The signaling story seems to be more applicable for self-tender offer repurchases than for open-market repurchase programs that generate significantly lower announcement returns.[3]

Very little theoretical research builds on the agency costs of free cash to explain a general payout policy. Chowdhry and Nanda (1994) and Lucas and McDonald (1998) build on free cash waste and asymmetric taxation of dividends and repurchases and focus on signaling results. Once announced, the repurchases in these models are not optional and thus apply to tender offers which are performed publicly and relatively immediately (generally within one month) rather than to open-market programs which are executed at the firm's discretion over a long period of time (generally 1-3 years).[4] Allen, Bernardo and Welch (2000) consider both agency costs of free cash and signaling motivation for disbursing cash through dividends. More recently, Decamps Mariotti, Rochet and Villeneuve (2011), and Lambrecht and Myers (2012) consider optimal stock issuance and dividend policies in the presence of agency costs of free cash and investment needs. These models however do not consider repurchases. Oded (2009) considers how uncertainties in firm value and in free cash interact to affect the bid-ask spread and repurchase program execution rate, but does not consider dividends.

Free cash flow based models are more common in capital structure theory. Jensen (1986) suggests that debt could solve the problem by removing the free cash. However, he only considers this advantage of debt. He does not consider that debt, as a firm commitment relative to payout, can constrain investment. Zwiebel (1996), for example, suggests that threat of a takeover is enough to discipline managers to disburse free cash. Stulz (1990) uses the overinvestment and underinvestment problems to explain capital structure. In his model, payment to debt is the predetermined payout mechanism that solves the overinvestment problem at the cost of exacerbating the underinvestment problem. The role of dividend in our model is similar to the role of debt payments in these capital structure models, in being a firm commitment to remove cash. But otherwise, our model is different. First, dividends are not subject to important flaws of debt (e.g. agency costs of debt and bankruptcy). Furthermore, existing capital structure models do not have repurchases as a flexible payout tool that can provide trading gains to management. Consequently, unlike in our model, in existing capital structure models management does not have a choice, or an incentive, to disburse free cash.[5]

[3] The average announcement return on self-tender offers is about 15% compared to only about 2% for repurchase programs. See, for example, Comment and Jarrell (1991). Furthermore, while tender offers can be withdrawn, most of them are executed. The announcement of an open-market repurchase program, however, does not constitute a commitment to repurchase, which is needed for signaling results. See, however, Oded (2005), and Peyer and Vermaelen (2009).

[4] We do not consider tender offers in this paper. Of all stock repurchases, more than 90% are performed through open-market programs (see, for example, Banyi, Dyle and Kahle 2008).

[5] Chakraborty and Yilmaz (2011) show that the flexibility inherent in convertible bonds can prevent investment shaving by solving the adverse selection problem associated with stock issues. Their paper is not about

Existing empirical work about capital structure that considers the use of debt payments and dividends to reduce agency costs of free cash (e.g. Agrawal and Narayan, 1994), also does not consider share repurchases.

The agency costs of free cash flow theory has been criticized (e.g., Myers 2003, page 243) for taking as a given that insiders will spend free cash without explaining why they are doing so. Our model contributes to this literature in modeling the agency problem at a primitive level; that is, we explicitly model the insiders' benefits from waste. We suggest that insiders may pay out cash voluntarily if they have incentives in the form of gains from the firm's informed repurchase trade. At the same time, we elaborate on the agency problem in suggesting that the general shareholders trade off the waste prevention benefits from forcing cash out (by demanding dividends) against investment distortion. Our analysis considers payout policy as a problem of how to get free cash out of the firm under asymmetric information without reducing financial flexibility. We acknowledge that this approach leaves important aspects of the tradeoff between dividends and repurchases out of the analysis (e.g. taxes, signaling). We believe, however, that we highlight important aspects of payout policy that have been largely ignored in the theoretical literature and that these aspects may at times dominate all others.

Buffa and Nicodano (2008) and more recently, Babenko, Tserlukevich and Wan (2012) focus on agency problems in the form of wealth transfers under mispricing that open market repurchases engender, abstracting from free cash waste. Huang and Thakor (2013) consider share repurchases as a mechanism to remove pessimistic shareholders who may disagree with management decisions. Miller and Rock (1985) use the distortion of investment caused by payout as a basis for a dividend signaling model. Eastbrook (1984) suggests that dividends force managers to raise capital in order to avoid the distortion of investment and that the increased monitoring of the managers associated with the issuance reduces agency problems. Grullon Michaely and Swimanathan's (2002) maturity theory suggests that maturing firms experience a decline in risk and investment needs, resulting in increasing levels of free cash, and hence they start paying dividends.

3 A model of payout policy

We consider an all-equity financed and financially constrained firm. There are three dates indexed by $t = 0, 1, 2$. All agents are risk neutral, the interest rate is zero, and there are no taxes or transaction costs. At $t = 0$ the firm has an endowment i and an investment opportunity (project). For simplicity and without loss of generality we normalize the endowment to one

free cash.

($i = 1$). The firm is financially constrained, that is, no funds are available for investment other than the endowment. The size of the investment opportunity and the return on investment are uncertain at $t = 0$. At $t = 1$, the size of the investment opportunity is realized to be either $1-c$ (small) or 1 (big) with equal probability, where $0 < c < 1$. The portion of the endowment that is not needed for the investment then becomes "free cash." Thus, the level of free cash is realized to be either c or 0, depending on whether the investment opportunity is realized to be small or big. The expected return on investment is also realized at this point to be either $\alpha_1 = \alpha - \sigma$ (low) or $\alpha_2 = \alpha + \sigma$ (high) with equal probability. We assume $0 < \sigma < \alpha - 1$ so that $1 < \alpha_1 < \alpha_2$, and hence the expected return $(\alpha_1 + \alpha_2)/2 = \alpha > 1$.[6] We identify four possible states at $t = 1$: $\{SL, SH, BL, BH\}$ where S and B indicate small vs. big investment, and L and H indicate low vs. high return on investment. At $t = 2$, funds that were invested at $t = 1$ generate return according to the state realized at $t = 1$.

For simplicity and without loss of generality we normalize the number of shares outstanding N at $t = 0$ to one ($N = 1$). A fraction β of the shares is held by insiders, where $0 < \beta < 0.5$, and the rest is held by outside shareholders. The outside shareholders are thus the majority and dictate the (payout) policies of the firm. The insiders run the firm on behalf of all the shareholders. Each investor group acts to maximize its own wealth. The naive interpretation of the quantity β is insider ownership, but in practice β can be higher than the ownership if, for example, insiders have stock options or compensation contracts that are pegged to the growth of the firm. Such transfers to insiders would of course come at the expense of outside shareholders, as return on investment, α, is assumed to be exogenous (insiders always exert maximum effort). We bound β away from zero, because insiders likely always get a share of the pie, and away from 0.5, because we want to assume outsiders can establish policy (through the board, or shareholder meetings, or relationship investing).[7] In Section 5 we consider an extension of the model in which insiders are in control.

Information is symmetric at $t = 0$, but at $t = 1$ the realizations of the size of the investment opportunity (1 or $1 - c$) and the expected return on investment (α_1 or α_2) are observable by

[6] For simplicity of exposition, return is gross return, that is, proceeds from the investment. We require that investment is efficient in every state in order to make the financial constraints significant. The model only requires that investment is, in expectation, efficient, that is, that $1 < \alpha$ and $\sigma < \alpha$. If $\alpha < 1$ the firm will never invest.

[7] The assumption that insider ownership is low is consistent with the empirical evidence. In a sample of large US firms, Ofek and Yermack (2000) find that 90% of the CEOs own less than 5% of the shares. Similary, Jensen (2000) reports that insider ownership in the US is only 1-5%. In practice, insiders are often in control even without majority ownership. We, however, want to consider payout policy as a governance mechanism and hence focus on a principal-agent framework in which outside shareholders are the principal and the insider shareholders are the agent.

the insiders only. At $t = 2$ all information is public, the firm is dismantled, and shareholders are paid in proportion to their ownership.

Agency Problem – Any funds not invested in the project at $t = 1$ (i.e., all free cash) are completely wasted by the insiders between $t = 1$ and $t = 2$, unless these funds are paid out immediately at $t = 1$. The insiders realize private benefits of γ on every dollar they waste, where $0 < \gamma < 1$. The waste of free cash is thus costly to all shareholders, but benefits accrue only to insiders.[8] We assume away the situation in which insiders will waste cash that is not free (choose to shave investment at $t = 1$). Presumably when investment size is realized at $t = 1$, cash that is not free is already tied to the investment.[9]

Further elaboration on the parameter γ is warranted. Unlike the parameter β which pertains to the zero-sum game between insiders and outsiders, the parameter γ directly affects only the insiders. We interpret the parameter γ, capturing insiders' benefits from waste, as a quality-of-governance parameter. That is, insiders always find a way to waste free cash. When governance is poor, insiders are able to spend directly on things they benefit from the most (perks); when governance is good, this is not an option. In the latter case, insiders are able to waste free cash only on things that look like they are good for the firm (i.e., "empire building"), and they receive fewer private benefits. Better governance and monitoring are thus associated with lower γ; they make it harder for insiders to choose wasting activities yielding considerable private benefits. For example, γ is relatively low if the insiders use excess cash to hire redundant employees and invest in redundant (bad) projects. It is higher if they can spend excess cash on art collection or vacation trips. It is relatively easy to present empire building activities as necessary expenses but much harder to do so with perks. Waste activities with high γ are less relevant to the enhancement of firm value, and hence we argue that better governance is associated with lower γ.[10] We further assume that $\beta < \gamma$, that is benefits from

[8] Essentially, we assume here that insiders cannot prevent the waste of the free cash under their control, even if it is in their interest as a group to do so. This could be because of a coordination problem, where each insider has an incentive to deviate from the insider social optimum. Sooner or later, an insider will find a way to waste the free cash and privately enjoy the benefit. In this case γ should be thought of as *expected* private benefits from waste. Under a reduced agency problem where this assumption is relaxed, the results of the model are the same with the exception that in the range $\gamma < \beta$ there is no agency problem (free cash waste), resulting in no payout.

[9] When realized investment opportunity is big, if the insiders can be allowed to lie that the opportunity is small and waste the remaining cash (or repurchase) the additional parameter restriction $\gamma < \beta(\alpha - \sigma)$ assures insiders are better off not lying so that the equilibrium is robust. The proof is available from the authors upon request.

[10] On the general association between the quality of governance and waste, see, for example, Shleifer and Vishny (1997). The waste of free cash need not be the result of insiders actively wasting the cash, but can rather be the result of passive management because of the availability of free cash, as in the "quiet life" models (e.g., Bertrand and Mullainathan 2003).

waste are always higher than the fraction of shares held by insiders (see section 3.4 for support for this assumption in the empirical evidence).

Payout Policy – At $t = 0$ the outside shareholders can 1) demand a dividend; 2) approve (announce) an open-market stock repurchase program; or 3) do nothing. A dividend forces cash out immediately at $t = 0$. An open-market program announcement authorizes but does not commit the insiders to buy back shares at $t = 1$. Execution of the program takes place at the managers' discretion, and is not contractible. Information as to whether the firm repurchased or not becomes public only at $t = 2$.[11] Without loss of generality, we assume that outside shareholders will "do nothing" whenever they are indifferent. Without loss of generality, we also assume that if the outsiders announce a repurchase program, managers (insiders) will repurchase rather than waste the free cash whenever they are indifferent.

Trade – At $t = 1$ a subset of the *outside* shareholders face liquidity constraints and must sell a portion q of their shares, where $q < (1 - \beta)$. Insiders, cannot trade *their own* shares in the market at $t = 1$, however.[12] There is a market for the stock in which the market maker sets the price p before investors place their quantity bids (anticipating the possibility of informed trade from the firm side) to earn zero expected profit.[13] We will generally omit the time index for $t = 1$, as most of the action happens on this date. Figure 1 describes the time line.

Definition 1 *Equilibrium is a set consisting of 1) payout policy set by the outside shareholders that specifies one of the following: a dividend, an open-market program announcement, or no payout; 2) a price p set by the market maker, given the payout policy; and 3) a repurchase*

[11] In the US, corporate boards announce dividends and authorize repurchase programs. In most other countries these practices must be approved either by the board or by the shareholders. In our model the outside shareholders are essentially the board. In the US there is no reporting requirement on actual repurchases other than in the financial statements. The regulation of actual repurchases in other countries is more restrictive. Generally firms cannot start a repurchase program without announcing it before hand. (In the US this requirement comes from the exchanges.)

[12] In the US, SEC Rule 10b-5 requires insiders—including the firm and its officers—to refrain from trading in the firm's shares while in possession of "material" non-public information regarding their value.

The restriction on liquidity trade $q < (1 - \beta)$ is made without loss of generality, and limits the discussion to the feasible range of the results. While we allow outsiders to trade more than q shares, as will be shown, trading only the liquidity needs q is supported by the equilibrium.

[13] Prices are thus independent of the actual order flow as in Glosten and Milgrom (1985), Rock (1986), and Noe (2002). We focus on $t = 1$ because this is when the repurchase takes place, but it could be assumed that the market opens also at $t = 0$ and $t = 2$.

At the cost of significantly complicating the analysis, it is possible to have a two-sided market where liquidity buyers and sellers place ask and bid quantities, and the market maker posts ask and bid prices. Informed trade in this case is possible only in the ask market. The qualitative results and their implications for payout policy under such an alternative market mechanism are the same.

strategy set by the insiders if the payout policy is an open-market program, given p, such that the market maker makes zero expected profit and each shareholder group (insider and outsider) maximizes its wealth, given the information it has.

We first note that when the outside shareholders determine the payout policy (dividend, repurchase or no payout) they do so before knowing the realized investment size and profitability. Therefore, the choice of distribution method has no signaling effect.[14] The analysis to follow will show that if the policy set by the outside shareholders is no payout, the firm has very good financial flexibility, but all free cash is wasted. With a dividend payout, all cash taken out is saved (not wasted). In this case there may be a shaving of investment, if investment opportunity is later realized to be large. An open-market program allows the insiders to cancel the payout (refrain from buying shares at $t = 1$) if it turns out that the firm does not have free cash, so that financial flexibility is retained. Insiders may choose to waste free cash when they do not have enough incentive to repurchase. However, they may also repurchase strategically, because they are privately informed about the firm's prospects at $t = 1$. This strategic trading (repurchasing) results in wealth transfers to the insiders at the expense of uninformed (outside) shareholders. Despite these wealth transfers that adversely affect uninformed shareholders, an open-market program will often dominate the other policies because it avoids investment shaving and partially prevents free cash waste.

The investigation is performed in stages. First, we analyze the effect of disbursing a dividend, assuming it is the only available payout method. Then, we analyze the effect of a repurchase program, assuming it is the only available payout method. Finally, we combine the two results to characterize the payout policy, that is, to suggest how outside shareholders will choose among a dividend, an open-market repurchase program, and no payout.

3.1 Dividend

At $t = 0$ the outside shareholders can force payment of a dividend d, where $0 \leq d \leq 1$. Suppose that the dividend is the only available payout method. In this case, if the investment opportunity is later realized to be small (i.e. $1 - c$), then with $d \leq c$ cash would be saved and investment would not be constrained. However, if instead the investment opportunity is realized to be big (i.e. 1), the firm cannot fully take advantage of the opportunity and has to shave investment. In this case the realized return will accrue only on the funds invested, where funds invested are the minimum between investment size realized and available cash.

[14] In the extension section (Section 5) we consider an alternative setup in which insiders rather than outsiders are in control, and choose distribution mode *after* observing the realized outcome.

The firm value depending on d is thus

$$\alpha\left[(1-d)-\frac{(c-d)^{+}}{2}\right]+d \tag{1}$$

where $x^{+}\equiv\max\{x,0\}$.

Proposition 1 *Suppose the only available method to distribute free cash is a dividend. Then expected firm value (including the dividend) is maximized by choosing* $d=c$ *if* $\alpha<2$ *and* $d=0$ *otherwise.*

Proofs of all lemmas and propositions appear in the Appendix. Proposition 1 suggests that if the firm can only choose between a dividend and no payout at all, it will prefer a dividend of $d=c$ when $\alpha<2$ and prefer no payout otherwise. Intuitively, there is some level of expected return on investment below which the benefit from waste prevention through payment of a dividend is higher than the cost incurred from shaving investment, and above which the situation is reversed.

3.1.1 Dividend wealth effects and optimal dividend

When dividend disbursement is the only available payout method, maximizing the value for outside shareholders is equivalent to maximizing the expected firm value (including the dividend). This is because dividends paid are pro-rata, so the level of insider ownership β is irrelevant. Thus, given the result in Proposition 1, outside shareholders will demand a dividend of c if $\alpha<2$ and will not demand a dividend payment otherwise. Indeed, if $d=c$, outside shareholder wealth is

$$(1-\beta)(\alpha(1-c)+c)=(1-\beta)(\alpha+c-\alpha c).$$

If $d=0$, outside shareholder wealth is

$$(1-\beta)\,\alpha\left(1-\frac{c}{2}\right).$$

The difference in outside shareholder wealth between a dividend of c and no dividend is

$$(1-\beta)\,c\left(1-\frac{\alpha}{2}\right). \tag{2}$$

Note that this difference is positive if and only if $\alpha<2$, consistent with Proposition 1.

3.2 Repurchase

At $t = 0$ the outside shareholders can choose to announce an open-market repurchase program. A repurchase program announcement publicly authorizes the firm (insiders) to repurchase shares up to a dollar value of c, but does not commit the firm to repurchase. Because a repurchase is executed through the financial markets, the existence of an equilibrium with a repurchase announcement depends on the post-announcement response in the financial markets of: 1) the market maker, 2) the general shareholders (the outsiders), and 3) the firm (the insiders). In this subsection we consider the conditions under which such an equilibrium can hold. We abstract from dividends and assume that the only way to pay out free cash is a repurchase program. Under this assumption we characterize the existence of an equilibrium with a repurchase program and the way the outside shareholders choose between a repurchase program announcement and no payout. Then, in subsection 3.3, we will characterize the choice among all possible payout policies (repurchase, dividend, and no payout).

Suppose first that the firm does not announce a repurchase at $t = 0$ and hence never repurchases at $t = 1$. In this case, free cash is always wasted. Without a repurchase announcement, if investment is realized to be big, that is, in the states BL and BH, all the endowment is invested and hence p_{2NA}, the $t = 2$ price without a repurchase announcement, is $\alpha_1$and α_2, respectively. If instead, investment is realized to be small, that is, in the states SL and SH, only $1 - c$ is invested while the rest, c, is wasted. In these states, p_{2NA} is $\alpha_1(1 - c)$ and $\alpha_2(1 - c)$, respectively. Because all states are equally likely then

$$E[p_{2NA}] = \frac{1}{4}[\alpha_1 + \alpha_2 + \alpha_1(1 - c) + \alpha_2(1 - c)] = \frac{1}{4}(\alpha_1 + \alpha_2)(2 - c) = \alpha(1 - \frac{c}{2}).$$

Going back to $t = 1$, denote the price that the market maker sets at $t = 1$ absent a repurchase announcement by p_{NA}. The market maker zero-profit condition is

$$0 = E_i[(p_2 - p_{NA})q_i]$$

where i indicates the four possible states $i \in \{BH, BL, SH, SL\}$, and q_i is the quantity the market maker gets to buy in each of the states i. Now, in the case of no repurchase announcement the market maker always buys the same quantity $q_i = q$ and accordingly, the market maker zero-profit condition becomes:

$$(\alpha_1 - p_{NA})q + (\alpha_2 - p_{NA})q + (\alpha_1(1 - c) - p_{NA})q + (\alpha_2(1 - c) - p_{NA})q = 0. \tag{3}$$

Upon rearrangement we can write

$$p_{NA} = \frac{1}{4}(\alpha_1 + \alpha_2)(2 - c) = \frac{\alpha}{2}(2 - c) = \alpha(1 - \frac{c}{2}) = E[p_{2NA}]. \tag{4}$$

Alternatively, suppose that at $t = 0$ the outside shareholders authorize a repurchase program. In the states $\{BL,\ BH\}$ all cash is tied to the investment opportunity. Accordingly, in the states BL, BH, p_2 is the same as in the case of no repurchase, that is, α_1 and α_2, respectively. In the states SL, SH, if the firm decides not to repurchase, then p_2 is also the same as in the case of no repurchase, $\alpha_1(1 - c)$, and $\alpha_2(1 - c)$, respectively. But, if the firm's strategy is to repurchase at $t = 1$ in these states, the price p_2 is increased relative to the case of no repurchase. This is because cash that would otherwise be wasted is used by the firm to buy back shares and thereby to reduce the number of shares outstanding, while the firm value is unchanged.[15] Specifically, in case the of a repurchase

$$p_2 = \frac{\alpha_i(1 - c)}{1 - \frac{c}{p}} \tag{5}$$

where $i = 1, 2$, in states SL and SH, respectively, and where p is the price set by the market maker at $t = 1$ in the case of a repurchase announcement at $t = 0$.

3.2.1 Payoffs and repurchase wealth effects

Next consider the payoffs for the investment groups without and with a repurchase. Consider the insiders first. If investment is realized to be large (states BL and BH), they never waste free cash or repurchase. Their payoff is the fraction of their holdings times the firm's terminal value, that is, $\beta p_2 = \beta\alpha_i$, where $i = 1, 2$ in the states BL, BH, respectively. If, instead, investment is realized to be small (states SL, SH), then if the firm does not repurchase, insiders' payoff is the value of their holdings times the firm's terminal value plus their benefits from cash waste, whereas if they do repurchase their payoff is only the value of their holdings. That is, their payoffs without and with a repurchase are respectively,

$$\beta p_2 + \gamma c = \beta\alpha_i(1 - c) + \gamma c \text{ and } \beta p_2 = \beta\frac{\alpha_i(1 - c)}{1 - \frac{c}{p}},$$

[15] It is immediate to show that outside shareholders will not authorize a program larger than c (because $\alpha > 1$). Our results will show that whenever a repurchase can distribute the cash it is optimal to announce the whole amount c. We also assume insiders cannot repurchase when they do not have free cash, that is, in the states $\{BL,\ BH\}$. See footnote 9 about the implications of relaxing this assumption.

where $i = 1, 2$ in the states SL, SH, respectively. Given a repurchase announcement, for the firm's (insiders') strategy at $t = 1$ to be "repurchase" in either state SL or SH, it must therefore be that

$$\beta\alpha_i(1-c) + \gamma c \leq \beta\frac{\alpha_i(1-c)}{1-\frac{c}{p}}. \tag{6}$$

This decision rule can also be rearranged to trading gains vs. benefits from waste as

$$\gamma c \leq \beta\alpha_i(1-c)\frac{c}{p-c}. \tag{7}$$

Now, consider the outside shareholders. Their payoff is always what they get for the shares they liquidate at $t = 1$ plus the value of their remaining shares at $t = 2$. That is, the payoff to the outsiders is $(1-\beta-q)p_2 + qp$ regardless of whether there is a repurchase or not. When investment is realized to be big, that is, in the states BL and BH, the payoff to outside investors is always $(1-\beta-q)\alpha_i + qp$, where $i = 1, 2$ in the states BL, BH, respectively. If, instead, investment is realized to be small, that is, in the state SL and SH, the firm has free cash and it may repurchase or not. Outsiders' payoffs without and with a repurchase are then, respectively,

$$(1-\beta-q)\alpha_i(1-c) + qp \text{ and } (1-\beta-q)\frac{\alpha_i(1-c)}{1-\frac{c}{p}} + qp$$

where $i = 1, 2$ in the states SL, SH, respectively, and where p is the price set by the market maker at $t = 1$. Outsiders are uninformed and hence their decision to approve a repurchase depends on their expected wealth given the firm's repurchase strategy. That is, for the outsiders to approve a repurchase announcement, it must be that their expected wealth with a repurchase announcement is higher than without a repurchase announcement. Specifically, for the outsiders to authorize a repurchase, it must be that

$$(1-\beta-q)E[p_{2NA}] + qp_{NA} \leq (1-\beta-q)E[p_2] + qp \tag{8}$$

where, as defined before, p_{NA} is the $t = 1$ price set by the market maker without a repurchase announcement, p_{2NA} is the share price (value) at $t = 2$ without a repurchase, p is price set by the market maker to make zero expected profit given the firm's strategy (at SL, SH, repurchase or not), and p_2 is the resulting terminal share value. The price p_2 now depends on both the state realized and on p. Upon substitution of $p_{NA} = E[p_{2NA}]$ we can rearrange (8) to

$$(1-\beta)p_{NA} \leq qp + (1-\beta-q)E[p_2]. \tag{9}$$

3.2.2 The market maker's strategy

Next, consider the market maker's strategy (the price p he sets at $t = 1$), given a repurchase announcement. By assumption, the market maker sets the price p that gives him zero expected profit. If, in equilibrium, the firm is expected to repurchase in both states SL and SH, then the market maker will set the price p such that:

$$0 = E_i[(p_2-p)q_i] = \frac{1}{4}[(\alpha_1-p)q+(\alpha_2-p)q+(\frac{\alpha_1(1-c)}{1-\frac{c}{p}}-p)(q-\frac{c}{p})+(\frac{\alpha_2(1-c)}{1-\frac{c}{p}}-p)(q-\frac{c}{p})]. \quad (10)$$

Alternatively, if, in equilibrium, the firm repurchases only in state SH, for example (which we will soon show is the only possible equilibrium strategy), the market maker will set the price p such that

$$0 = E_i[(p_2-p)q_i] = \frac{1}{4}[(\alpha_1-p)q+(\alpha_2-p)q+(\alpha_1(1-c)-p)q+(\frac{\alpha_2(1-c)}{1-\frac{c}{p}}-p)(q-\frac{c}{p})]. \quad (11)$$

In both such cases, however, $p \neq E[p_2]$ because $E[p_2]$, the expected $t = 2$ price, depends on the probabilities of the states that are equally likely, while p also takes into account the quantities that the market maker gets to buy. Indeed, if the firm's strategy is to repurchase in both states SH and SL then

$$E[p_2] = \frac{1}{4}[\alpha_1+\alpha_2+\frac{\alpha_1(1-c)}{1-\frac{c}{p}}+\frac{\alpha_2(1-c)}{1-\frac{c}{p}}] = \frac{1}{2}[\alpha+\frac{\alpha(1-c)}{1-\frac{c}{p}}], \quad (12)$$

and if the firm's strategy is to repurchase only in state SH then

$$E[p_2] = \frac{1}{4}[\alpha_1+\alpha_2+\alpha_1(1-c)+\frac{\alpha_2(1-c)}{1-\frac{c}{p}}] = \frac{1}{2}[\alpha+\frac{1}{2}(\alpha-\sigma+\frac{\alpha+\sigma}{1-\frac{c}{p}})(1-c)].^{16} \quad (13)$$

Given a repurchase strategy set by the firm (repurchase either in state SH or in both states), the market maker adjusts the price p he sets at $t = 1$ relative to the no -announcement price p_{NA} to account for two effects. The first effect is the expected per-share value enhancement from the use of free cash in the firm's repurchase trade. That is, whenever the firm repurchases, cash that would otherwise be wasted is used to repurchase shares outstanding

[16] Indeed, if the firm repurchases in both states SL and SH it can be shown using (10) and (12) that $p > E[p_2]$.The relation between p and $E[p_2]$ when the firm repurchases only in the state SH, that is, between the expressions in (11) and (13) depends on parameter values, as will be demonstrated in Lemma 2.

and hence the same terminal firm value is divided by a smaller number of shares. This effect enhances the expected terminal share value, $E[p_2]$, and hence also acts to increase the price p at which the market maker is willing to buy shares at $t = 1$ over the no-announcement price p_{NA}.

The second effect is the expected wealth transfers associated with mispricing. Specifically, because the market maker sets one price p while the value realized is state dependant, the firm may have either trading gains or losses from the repurchase trade depending on the direction of the mispricing. Because the market maker sets p to have zero expected profit, expected trading gains to the firm from the repurchase act to reduce the price p and result in wealth transfers to the firm from the selling (outside) shareholders; expected trading losses to the firm from the repurchase act to increase the price p and result in wealth transfers from the firm to the selling shareholders.

Next, consider the combined impact of these effects (value enhancement and wealth transfers) on equilibrium prices. Without a repurchase announcement, there is no repurchase trade and hence $p_{NA} = E[p_{2NA}]$. Given a repurchase announcement, $E[p_2]$ is increased relative to $E[p_{2NA}]$ because of the value enhancement effect, while the wealth transfer effect determines whether $p < E[p_2]$ or $p > E[p_2]$. However, $p > E[p_2]$ is not sustainable in equilibrium, as it necessitates that the firm buys overpriced shares. Under our assumption $\beta < \gamma$, insiders are always better off wasting cash than repurchasing overpriced shares and hence $p > E[p_2]$ is not a sustainable equilibrium outcome. Therefore, in any equilibrium with a repurchase announcement $p \leq E[p_2]$.

Based on the requirement $p \leq E[p_2]$ we now show (by contradiction) that a situation in which the firm repurchases whenever it has free cash is not an equilibrium. Suppose the informed insiders' strategy is to repurchase whenever free cash is available, that is, in both states $\{SL, SH\}$. In this case, the firm repurchases shares whenever the investment prospects are bad (free cash is available), and hence subsidizes the market maker's losses when he loses but does not participate in the gains when he wins. This is because the market maker buys q shares when investment prospects are relatively good but only $q - \frac{c}{p}$ shares when investment prospects are relatively bad. As a result, the repurchase price that the market maker will set to earn zero expected profit is higher than the expected value ($p > E[p_2]$), in which case equilibrium cannot hold. Only if the firm repurchases strategically (only in state SH) is it possible for the market maker to set $p \leq E[p_2]$ and for the equilibrium to hold. The following lemma formally establishes these results.

Lemma 1 *In any equilibrium in which a repurchase program is announced:*
(i) the following condition must hold

$$p \leq E[p_2], \tag{14}$$

and (ii) the firm repurchases only in the state $\{SH\}$.

Condition (14) is a no-trading losses to insiders condition: Given a repurchase announcement, the expected terminal price must be higher than or equal to the price the market maker buys for at $t = 1$. The requirement that the firm repurchase only in the state $\{SH\}$ follows because if the firm repurchases in both states SL, SH, the market maker will set $p > E[p_2]$ which in turns means the firm is buying overpriced shares in the state SL, while the assumption $\gamma > \beta$ means insiders are not willing to tolerate trading losses in any state. This also means that for condition (14) to hold, a repurchase cannot be associated with bad news about investment prospects.

The results in Lemma 1 reflect that with information asymmetry, if the market maker breaks even, and there is gain from informed trade, then the informed party can reap trading profit at the expense of uninformed shareholders. The resulting adverse selection from the firm side, however, indicates that a repurchase cannot distribute all free cash, consistent with the empirically low actual repurchase rates of repurchase programs.

Because in any equilibrium with a repurchase announcement the firm executes the program only in the state $\{SH\}$, the market maker condition is (11) and can be rearranged to

$$(\alpha_1(1-c)-p)q + (\frac{\alpha_2(1-c)}{1-\frac{c}{p}} - p)\left(q - \frac{c}{p}\right) + (\alpha_1 - p)q + (\alpha_2 - p)q = 0 \tag{15}$$

and recall $\alpha_1 = \alpha - \sigma$ and $\alpha_2 = \alpha + \sigma$. This condition essentially requires that the average of the differences between the price that the market maker is willing to buy for and the terminal value of a share, weighted by the quantity bought in each state, be zero. The first term corresponds to the state $\{SL\}$ where investment opportunity is small and expected return is low, so the firm value is very low and hence insiders will not execute the repurchase despite the availability of free cash. The third and fourth terms correspond to the states $\{BL, BH\}$, respectively. In these states, investment opportunity is realized to be big, so the firm does not have free cash and hence does not repurchase.

The second term corresponds to the state $\{SH\}$, where investment opportunity is small but return on investment is high. If in this state the insiders do not repurchase there will be no repurchase in any state and therefore there is no point in announcing a repurchase program. Thus, in an equilibrium with a repurchase announcement, the firm does repurchase in this state, and the fraction of shares repurchased is $\frac{c}{p}$. At $t = 2$ the proceeds from the investment are $\alpha_2(1-c)$, and hence the terminal value per share in this state is $\frac{\alpha_2(1-c)}{1-\frac{c}{p}} = \frac{(\alpha+\sigma)(1-c)}{1-\frac{c}{p}}$.

The requirement that the firm will repurchase only in state $\{SH\}$ is necessary but not sufficient for $p \leq E[p_2]$ to hold. Lemma 2 uses the market maker condition (15) to solve for p and to provide a necessary and sufficient requirement for $p < E[p_2]$. For simplicity of exposition, we henceforth assume the inequality is strict.

Lemma 2 *In any equilibrium in which a repurchase program is announced:*
(i) the price p *at which the market maker sells for at* $t = 1$ *is*

$$p = \frac{p_{NA} + c\frac{1+4q}{4q} + \sqrt{\left(p_{NA} + c\frac{1+4q}{4q}\right)^2 - c\left[4p_{NA} + c\frac{1}{q} + (\alpha+\sigma)(1-c)\frac{1-q}{q}\right]}}{2}, \tag{16}$$

where p_{NA} *is the no-announcement price given in (4),*
(ii) the condition $p < E[p_2]$ *is equivalent to*

$$p < (\alpha + \sigma)(1 - c) + c, \tag{17}$$

and (iii) condition (17) is equivalent to

$$\frac{c}{1-c} < \frac{2\sigma}{\alpha - \frac{2}{3}} \tag{18}$$

Part (i) of Lemma 2 is derived by solving the market maker condition (15) for the price p. Part (ii) of Lemma 2 is derived by imposing the restriction $p < E[p_2]$ from (14) on the market maker condition (15). Last, part (iii) of Lemma 2 is derived by combining the restrictions in parts (i) and (ii) on the price p to give the necessary and sufficient condition on the model parameters under which the restriction $p < E[p_2]$ will hold.

Condition (18) is a condition for the expected wealth transfer to be from the liquidity sellers to the firm and not the other way around. This is essentially a condition under which the share's value in the repurchase state $\{SH\}$ exceeds the average in all the other states. By observation, condition (18) requires that either c is low, or σ is sufficiently high relative to α. Intuitively, the higher the c, the lower the value of the firm when investment opportunity is realized to be small, and hence, even if the firm repurchases only in the state with high return $\{SH\}$, the stock value in this state will be lower than the price p. As a result, the direction of the wealth transfer will be from the firm to the selling shareholders, and the requirement $p < E[p_2]$ will not hold. On the other hand, the higher σ relative to α the wider the gap between α_1 and α_2, and the more likely it is that in the state $\{SH\}$ the stock value is high compared to the price p. As a result the direction of the wealth transfer is from selling shareholders to the firm, and the requirement $p < E[p_2]$ will hold.

3.2.3 Insider's optimal strategy

Lemmas 1 and 2 give restrictions that originate in the zero-expected-profit for the market maker condition and the condition $p < E[p_2]$. For a repurchase equilibrium to hold, it is also necessary that the insiders will find it optimal to repurchase in the state $\{SH\}$ and only in that state. That is, condition (6) must hold for α_2 and must not hold for α_1. Lemma 3 gives restrictions on p such that insiders will repurchase only in this state.

Lemma 3 *Insiders will execute the repurchase in the state $\{SH\}$, and only in that state, if*

$$\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c < p < \frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c, \tag{19}$$

where p is given in (16).

Condition (19) is the insider participation condition. It indicates the restrictions on the price p such that the insiders will execute the repurchase in the state $\{SH\}$ and only in that state. To earn zero expected profit, the market maker sets the price according to (16). At this price, $\frac{\beta}{\gamma}$ must be high enough for benefits from repurchase in state $\{SH\}$ to justify its execution. Namely, insider holdings β should be large enough so that insiders will have enough benefits from waste prevention through share value appreciation. At the same time, their benefits from waste γ must be low enough, or else the insiders will prefer to waste the cash. On the other hand, $\frac{\beta}{\gamma}$ cannot be too high. If it is, insiders will execute the repurchase also in state $\{SL\}$, and, as explained earlier in Lemma 1, the condition $p < E[p_2]$ will not hold.[17]

Next, Lemma 4 combines the restrictions in Lemmas 1, 2, and 3 – condition (14), the market maker condition (15), and the insiders' participation condition (19) – to characterize when a repurchase announcement can be an equilibrium outcome.

Lemma 4 *Let $p_R(\alpha, \sigma, c)$ be the price calculated in (16). A repurchase announcement can be an equilibrium outcome only if this price satisfies:*

$$\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c < p_R < \min(\frac{\beta}{\gamma}, 1)(\alpha + \sigma)(1 - c) + c \tag{20}$$

[17] It is possible to express the price p in (18) using the model parameters as in (19). Yet, because the price p is independent of $\frac{\beta}{\gamma}$ this complex presentation obscures rather than clarifies the intuition.

3.2.4 Outside shareholders' optimal strategy and repurchase equilibrium

Moving back to $t = 0$, in our current setup, outsiders are in control and set payout policies to maximize their own wealth. Thus, for the outside shareholders to authorize a repurchase program at $t = 0$, not only must the condition in Lemma 4 hold but a repurchase announcement must also dominate the policy of no payout for the outside shareholders. When considering the wealth effects of a dividend, there was no informed trade and hence we could simply identify outsiders' wealth with the value of the $(1-\beta)$ shares (including the dividend). When the payout policy is to repurchase, however, liquidity sellers are adversely affected by the firm's informed trade.

Given our assumption that liquidity sellers are outside shareholders, outsiders considering whether to announce a repurchase or not, consider the wealth of all outside investors.[18] As demonstrated in subsection 3.2.1, the expected wealth of outside shareholders is the expected wealth of liquidity sellers at $t = 1$ and of outside shareholders who sell their shares only at $t = 2$. Thus, under a repurchase program announcement, the expected wealth of outside shareholders is given by

$$qp + (1-\beta-q)E[p_2] \tag{21}$$

where p is from (16) and where

$$E[p_2] = \frac{1}{4}[\alpha_1(1-c) + \alpha_1 + \frac{\alpha_2(1-c)}{1-\frac{c}{p}} + \alpha_2] = \frac{1}{4}[(\alpha-\sigma)(2-c) + (\alpha+\sigma)\left(\frac{1-c}{1-\frac{c}{p}} + 1\right)]. \tag{22}$$

As is also demonstrated in subsection 3.2.1 in (9), for a repurchase program announcement to dominate a policy of no payout, outside shareholders' expected wealth with a repurchase announcement must be higher than their expected wealth without it, that is,

$$(1-\beta)\, p_{NA} < qp + (1-\beta-q)\, E[p_2].$$

This condition can be rearranged to

$$q\left(E[p_2] - p\right) < (1-\beta)\left(E[p_2] - p_{NA}\right). \tag{23}$$

Proposition 2 *Suppose the only available method to distribute free cash is a repurchase program. Then if condition (20) holds, for the outside shareholders, announcing a repurchase*

[18] Whose value the firm is maximizing is an open question in corporate finance. See, for example, Myers and Majluf (1984), and more recently, Babenko, Tserlukevich and Vedrashko (2012).

always dominates no payout. Therefore, a repurchase announcement will be the equilibrium outcome whenever condition (20) holds. Otherwise, there will be no payout.

Proposition 2 establishes that if a repurchase announcement can hold as an equilibrium outcome it is always better than a policy of no payout. Essentially the proposition states that whenever condition (20) in Lemma 4 holds condition (23) will also hold, and following a repurchase program announcement, the expected gains to outsiders from preventing the waste of free cash always outweigh their loss to insiders from adverse selection. Therefore, it establishes that when the only method to disburse free cash is a repurchase program, condition (20) in Lemma 4 is the condition for the existence of an equilibrium with repurchase announcement (henceforth, "a repurchase equilibrium.")

3.2.5 Feasibility of repurchase – numerical example

The following numerical example demonstrates the manner in which the existence of a repurchase equilibrium depends on the model parameters. Let the ratio between insider ownership and expected benefits from waste be $\beta/\gamma = 0.8$. Assume also that expected return on investment is $\alpha = 3.5$, variability of the return on investment is $\sigma = 1.5$, and free cash in the small investment scenario is $c = 0.2$. Also, liquidity trade at $t = 1$ is $q = 0.3$.

Using (4), $p_{NA} = 3.2$. Upon substitution of the parameter values above into (20), the repurchase equilibrium condition becomes $1.48 < p_R < 3.4$. Using (16), $p_R = 3.159$, and hence, a repurchase equilibrium exists.

In Figures 2–4 we show how feasibility of repurchase equilibrium in this numerical example depends on parameter values. Figure 2 demonstrates how the existence of a repurchase equilibrium in this example depends on the ratio between insider ownership and benefits from waste, $\frac{\beta}{\gamma}$. First we change the ratio $\frac{\beta}{\gamma}$ in the range $[0, 2.5]$, holding all other parameters fixed. In the figure, the lower horizontal line represents the price p, and the upper horizontal line represents $E[p_2]$. Both lines are horizontal because both p and $E[p_2]$ do not vary with $\frac{\beta}{\gamma}$.

Feasibility of a repurchase equilibrium requires that the condition $p < E[p_2]$ holds, that is, that the line p is below the line $E[p_2]$. Under the parameter values in this example, Figure 2 shows that this condition is always met. The two diagonal lines that start at the origin represent the limits on p in the insider participation condition (19) for different values of $\frac{\beta}{\gamma}$. Specifically, the lower diagonal line represents the term $\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c$ and the upper (steeper) diagonal line represents the term $\frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c$.

Feasibility of a repurchase equilibrium also requires that the insider participation condition (19) holds, that is, that the line p will be between the diagonal lines. Figure 2 indicates that for values of $\frac{\beta}{\gamma}$ below 0.75, the line p is above the diagonal lines. Namely, the condition

$p < \frac{\beta}{\gamma}(\alpha+\sigma)(1-c)+c$ does not hold. In this range, there is too little incentive to repurchase because insiders' benefits from waste prevention are low relative to their gains from waste. In this range, the firm will never repurchase. For values of $\frac{\beta}{\gamma}$ in the range $[0.75, 1.8]$, the price line p is between the diagonal lines so that the firm will repurchase only in state $\{SH\}$ and a repurchase equilibrium exists. For values of $\frac{\beta}{\gamma}$ above 1.8, the price line p is below both diagonal lines. Namely, the condition $p > \frac{\beta}{\gamma}(\alpha-\sigma)(1-c)+c$ does not hold. Consequently, the insiders will repurchase whenever the firm has free cash, that is, in both states $\{SL, SH\}$. This, in turn, will result in $p > E[p_2]$, and hence in this range a repurchase equilibrium cannot hold.

In general, for values of $\frac{\beta}{\gamma}$ close to 1, the benefits from waste are of the same magnitude as the benefits from waste prevention, so the ratio $\frac{\beta}{\gamma}$ is irrelevant for the existence of repurchase equilibrium. However, when this ratio deviates from 1, the incentive to repurchase becomes either too strong or too weak, and as a result, a repurchase equilibrium cannot hold.

Figure 3 demonstrates how the existence of a repurchase equilibrium depends on the variability in free cash c (equivalently, the variability in the size of the investment opportunity). Specifically, in the numerical example, we change the parameter c in the range $[0, 1]$, holding all other parameters fixed. As in Figure 2, the lower and the upper diagonal lines that meet at $c = 1$ represent the limits $\frac{\beta}{\gamma}(\alpha-\sigma)(1-c)+c$ and $\frac{\beta}{\gamma}(\alpha+\sigma)(1-c)+c$ in the insider participation condition (19), respectively. The concave diagonal line is $E[p_2]$, and the convex line is p.

Feasibility of a repurchase equilibrium requires that the line p be below the line $E[p_2]$ and between the lines $\frac{\beta}{\gamma}(\alpha-\sigma)(1-c)+c$ and $\frac{\beta}{\gamma}(\alpha-\sigma)(1-c)+c$. Figure 3 demonstrates that in the range $c < 0.38$ repurchase is feasible. Namely, the line p is between the lines $\frac{\beta}{\gamma}(\alpha-\sigma)(1-c)+c$ and $\frac{\beta}{\gamma}(\alpha+\sigma)(1-c)+c$, and below the line $E[p_2]$. As c increases (equivalently, as investment size in the small investment state drops), the value of the firm when the investment opportunity is realized to be small declines. For $c > 0.38$, this value becomes too low compared to the price p (which averages across small and big investment states) so that the condition $p < \frac{\beta}{\gamma}(\alpha+\sigma)(1-c)+c$ is violated. Namely, p becomes too high and hence the incentive to repurchase when free cash is available becomes too small even in the state with high return $\{SH\}$. As a result, the firm will never repurchase. For values $c > 0.6$, this price becomes even higher, so that the condition $p < E[p_2]$ also does not hold.[19] In general, a high value of c pushes the price p outside the range where repurchase equilibrium can hold.

Figure 4 demonstrates how the existence of a repurchase equilibrium depends on the vari-

[19] That is, on this off-equilibrium path, for $c > 0.6$ even if the firm were willing to incur losses and buy, at the price that gives the market maker zero expected profit all shareholders would want to sell.

ability in return on investment σ. Specifically, in the numerical example, we let σ vary in the range $[0, 1.5]$, holding all other parameters fixed (and recall $\alpha = 3.5$). The downward sloping line starting from level 2.44 at $\sigma = 0$ in Figure 4 represents the term $\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c$ in condition (19), and the upward sloping line that meets it at $\sigma = 0$ represents the term $\frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c$ in condition (19). The two (relatively) horizontal lines are p (drawn using squares) and $E[p_2]$ (drawn using 'x').

Feasibility of repurchase requires that the line p be below the line $E[p_2]$ and between the lines $\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c$ and $\frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c$. When σ is low, a repurchase equilibrium is not feasible. Indeed the line p is above the line $E[p_2]$ and above both the lines $\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c$ and $\frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c$. This happens because when variability in return on investment is relatively low, even small deviations of $\frac{\beta}{\gamma}$ from unity push the price p outside the feasible range dictated by (19) (see Figure 2). In this numerical example $\frac{\beta}{\gamma} = 0.8 < 1$, so p is above both lines $\frac{\beta}{\gamma}(\alpha - \sigma)(1 - c) + c$ and $\frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c$. That is, insider ownership is low compared to the benefits from waste, so there is not enough incentive for insiders to repurchase and prevent the waste of free cash. At the same time, the effect of the free cash c is relatively strong (see Figure 3) so that p is pushed above $E[p_2]$.[20] As σ is increased, the effects of both c and $\frac{\beta}{\gamma}$ are weakened. For $\sigma > 0.25$, the condition $p < E[p_2]$ holds, and for $\sigma > 1.15$, the condition $p < \frac{\beta}{\gamma}(\alpha + \sigma)(1 - c) + c$ also holds. Thus, for $\sigma > 1.15$, a repurchase is feasible. Figure 4 demonstrates that greater variability in return on investment generally puts the price p in the range where strategic repurchasing (i.e., repurchasing only in the state $\{SH\}$) is optimal for the insiders. At the same time, with enough variability in the return on investment the effect of free cash c is relatively weak so that the condition $p < E[p_2]$ holds.

Figures 2-4 illustrate together how the likelihood of a repurchase equilibrium to exist increases with the proximity of $\frac{\beta}{\gamma}$ to 1 and with variability in the rates of return on investment σ, and decreases with the variability of free cash c (equivalently, variability in the size of the investment opportunity).

3.3 Payout policy: Dividend, repurchase, or no payout

We can now combine the results from subsections 3.1 and 3.2 to characterize payout policy, that is, how a firm chooses among dividend, repurchase, and no payout when all these alternative payout policies are available. We first recall that it is the outside shareholders that set the policy, expecting the insiders response. The insiders can only determine whether to

[20] That is, on the off-equilibrium path, the price that gives the market maker zero expected profit would be too high so that the firm is not willing to repurchase.

repurchase or not if a repurchase program is announced by the outsiders. Consequently, the insiders' strategy affects payout policy only indirectly, through its expected impact on the terminal wealth of the outside shareholders. In order to predict the payout policy set by the outside shareholders, we need to consider the policy's impact on their wealth. The earlier analysis (subsections 3.1 and 3.2) suggests that the wealth of outsiders under different payout policies is as follows:

With no payout:

$$(1-\beta)\,p_{NA} = (1-\beta)\,\alpha\left(1-\frac{c}{2}\right) \tag{24}$$

With a dividend of c:

$$(1-\beta)\,(\alpha\,(1-c)+c) \tag{25}$$

With a repurchase program (in a repurchase equilibrium):

$$qp + ((1-\beta)-q)\,E[p_2] = (1-\beta)\,E[p_2] - q\,(E[p_2]-p) \tag{26}$$

where p and $E[p_2]$ are from (16) and (22), respectively. Using the wealth without a payout term (24) as a benchmark, comparing (24) through (26) is equivalent to comparing:

$$\begin{aligned} \text{No payout} &: \quad 0, \\ \text{Dividend of } c &: \quad (1-\beta)\,c\left(1-\frac{\alpha}{2}\right), \text{ and} \\ \text{Repurchase program} &: \quad (1-\beta)\,(E[p_2]-p_{NA}) - q\,(E[p_2]-p)\,. \end{aligned} \tag{27}$$

We already know from subsection 3.1 that, for the outsiders, if $2<\alpha$ a dividend is always dominated by no payout, and from subsection 3.2 we know that whenever a repurchase equilibrium exists it dominates no payout. So, suppose a repurchase equilibrium exists and suppose also that $2<\alpha$, then the outsiders' choice between a dividend and repurchase announcement depends according to (27) on whether

$$(1-\beta)\,c\left(1-\frac{\alpha}{2}\right) < (1-\beta)\,(E[p_2]-p_{NA}) - q\,(E[p_2]-p)$$

The following proposition builds on this relation to determine how the outsiders will choose between a repurchase announcement and a dividend.

Proposition 3 *For the outside shareholders, if a repurchase equilibrium exists, there exists some α_R*

$$2-\frac{1}{2\,(1-\beta)} < \alpha_R < 2$$

such that for all $\alpha < \alpha_R$ a dividend is the dominant payout policy and for all $\alpha > \alpha_R$ a repurchase is the dominant payout policy.

Proposition 3 suggests that if both repurchase and dividend dominate no payout, a dividend dominates a repurchase when expected return on investment α is relatively low, but a repurchase dominates a dividend when expected return on investment α is relatively high.[21]

Together, Propositions 1 through 3 suggest the following:

(i) If expected return on funds invested is very high $(2 < \alpha)$, a dividend is never an equilibrium outcome because it is dominated by a policy of no payout (Proposition 1).

(ii) If $\frac{\beta}{\gamma}$ is very low or very high, a repurchase is never an equilibrium outcome because it does not dominate no payout; if $\frac{\beta}{\gamma}$ is of moderate value, a repurchase will dominate no payout unless $\frac{\sigma}{\alpha}$ is low or c is high (Propositions 2).

(iii) If both repurchase and dividend dominate no payout, that is, if both $\alpha < 2$ and $\frac{\beta}{\gamma}$ is of moderate value, a dividend dominates a repurchase when expected return on investment α is relatively low $(\alpha < \alpha_R)$ whereas a repurchase dominates dividend when expected return on investment α is relatively high $(\alpha_R < \alpha < 2)$ (Proposition 3).

Results (i) – (iii) are summarized in Table 1.

Table 1: Optimal payout policy as a function of: $\frac{\beta}{\gamma}$ (insider benefit from waste relative to insider ownership), $\alpha = (\alpha_1 + \alpha_2)/2$ (expected return on funds invested), σ (variability in return on investment), and c (variability in free cash, or equivalently, in the size of investment opportunity).

	Low $\frac{\beta}{\gamma}$	**Moderate**$\frac{\beta}{\gamma}$			**High** $\frac{\beta}{\gamma}$
		Low $\frac{\sigma}{\alpha}$	**High** $\frac{\sigma}{\alpha}$		
			Low c	**High** c	
Low α	Dividend	Dividend	Dividend	Dividend	Dividend
Moderate α	Dividend	Dividend	Repurchase	Dividend	Dividend
High α	No payout	No Payout	Repurchase	No Payout	No payout

3.4 Empirical predictions

Table 1 offers the following empirical predictions about payout policy:

1) Higher expected return on investment (higher α) is associated more with repurchases than with dividends. Our interpretation of expected return is the firm's growth opportunities.

[21] In the model, the wealth effects of a dividend depend only on the expected return on investment α, while the wealth effects of a repurchase depend also on the variability in return on investment σ. In Proposition 3, the value of σ may affect the level of α_R but it does not alter the qualitative result.

2) Higher uncertainty about return on investment (higher $\frac{\sigma}{\alpha}$) is associated more with repurchase than with dividends. Our interpretation of uncertainty of return is how risky the firm's investments are.

3) Higher uncertainty about the levels of free cash (higher c) is associated more with dividends than with repurchase. Our interpretation of c is the agency costs of free cash flow. This is because the higher the c, the more severe the loss from the waste of free cash. Firms that face high uncertainty about their investment prospects risk amassing large sums of free cash that can be subject to severe waste. Because dividends are better than repurchases in preventing the waste of free cash, these firms will tend to disburse cash using dividends rather than using repurchases.

4) The prediction about $\frac{\beta}{\gamma}$ is less straightforward to interpret. Table 1 suggests that for a repurchase to be the preferred payout policy, $\frac{\beta}{\gamma}$ can be neither too low nor too high. Empirically, however, the former restriction seems to be the binding one. This is because as described in the introduction, most buybacks are only partly completed and tend to be welcomed in the financial markets as good news. This suggests that, in practice, there is less of an incentive to repurchase rather than too much of one, that is, levels of $\frac{\beta}{\gamma}$ are mostly low. Indeed, although we are not aware of empirical evidence on the benefits from waste γ, in practice β is very low (1%–5%, see footnote 8), suggesting that β is significantly lower than γ. Accordingly, our comparison with the empirical evidence will ignore the last column in Table 1 and focus on the restriction that $\frac{\beta}{\gamma}$ cannot be too low. Thus, one prediction is that high insider ownership (high β) makes repurchases more likely than dividends. Given the assumed association of private benefits to insiders from waste γ with governance quality, another prediction is that good corporate governance also makes repurchase more likely than dividends. Like high levels of free cash c, high levels of γ are associated with agency problems.

We can summarize the empirical predictions suggested by the model as follows:

1) Growth firms have low payouts. If they do disburse cash, they tend to do so with repurchases rather than with dividends. Mature firms have high payouts. They tend to distribute free cash with dividends more than with repurchases.

2) The riskier the firm, the more likely it is to disburse free cash with repurchases than with dividends.

3) Agency problems (either through availability of free cash or though poor-quality governance) make dividends more likely than repurchases.

4) Higher insider ownership makes repurchases more likely than dividends.

4 Empirical evidence, robustness, and further research

In this section we compare the model predictions to the empirical evidence, discuss the robustness of the results, and suggest directions for further research. The model predictions are broadly consistent with the empirical evidence.

Growth – Empirically, young growth firms that naturally have high investment needs tend to have no payout. It is the larger and relatively mature firms that pay out cash (see Grullon and Michaely 2002, and Fama and French 2002). Among the firms that do distribute cash to shareholders, growth firms that need financial flexibility prefer repurchases, while mature firms pay dividends (e.g. Guay and Harford 2000, and Brav et al. 2005). The association of financial flexibility with repurchases is also consistent with the findings in Dittmar and Dittmar (2008) that repurchases are correlated with business cycles, because, as they argue, investment needs are correlated with business cycles.

Risk – The model's prediction about risk is also supported by the data. Indeed the empirical evidence suggests that, among firms that pay out cash, riskier firms use repurchases whereas safer firms use dividends (e.g., Jagannathan et al. 2000, Grullon and Michaely 2002, and Chay and Suh 2009). In this respect, the increase in repurchase activity is consistent with evidence on the increase in idiosyncratic return volatility (e.g. Irvine and Pontiff 2009). Although the model is not dynamic, this prediction is also consistent with dividend smoothing (e.g., Lintner 1956, and more recently, Larkin, Leary and Michaely 2012). Specifically, if dividends are associated with stability and repurchases are associated with volatility, then dividends will be smooth while payout through repurchase will not. This explanation adds to existing explanations of dividend smoothing that focus on signaling motivation and include Kumar (1988), and more recently Guttman, Kadan and Kandel (2010).

Agency Problems – Agency problems in the model are generated both by high c (possible levels of free cash) and high γ (benefits to insiders from waste that we have identified with quality of governance). In the model, both will lead to a dividend rather than a repurchase. Consistent with this prediction, in an empirical study, John, Knyazeva and Knyazeva (2015) find that dividends are preferred over repurchases when agency problems are severe. While the literature suggests that in general agency considerations play a significant role in payout policy (e.g., Grullon and Michaely 2004), we are not aware of any study that investigates how the choice of payout method depends on governance quality. The cross-country evidence is consistent with the prediction that repurchases would be an efficient payout tool only in the presence of good governance. Indeed, repurchases are common practice only in countries that have good corporate governance, while countries with poor corporate governance tend to regulate repurchases strictly and even to ban them, suggesting that in these countries, repurchases cannot enhance the wealth of outside (uninformed) shareholders. In these poor corporate governance countries dividends are the only available payout method.[22] Overall the model suggests that better governance is associated with more payout, which is consistent with the findings in La Porta, Lopez-De Silanes, Shleifer and Vishney (2000).

Insider Ownership – The association between insider ownership β and repurchases is consistent with findings about the correlation between stock options and repurchases documented in Kahle (2002). While Kahle suggests that insiders use repurchases to compensate for the dilution of earnings from stock option grants, our model implies that it is also possible that stock options motivate insiders to pay out cash through repurchases by offering them a greater share of the benefit from waste prevention.

Insiders in Control – Our analysis focuses on the case in which outsiders are in control and set the payout policy. While technically, boards of directors determine payout policies, managers often have a big influence on these decisions. In the next section, we briefly consider an extension in which insiders are in control. It is shown that the qualitative results are similar to those summarized in Table 1. However, in this case, for dividends to be the dominant payout tool, the benefits from waste prevention must cover not only the losses from investment distortion but also the insiders' benefits from waste. Thus, if insiders are assumed to be in control, the prediction will be that firms are even less likely to pay out dividends. At the same time, there is higher motivation to announce a repurchase, because it is the insiders who benefit from the firm's informed trade, and they also benefit from free cash waste, when the repurchase is not executed. Thus our model predicts that other things being equal, when insiders are in control, there will be less dividend payouts and more repurchase payouts.

Simultaneous Use of Dividends and Repurchases – Like in all other theoretical analyses in payout policy we are aware of, in our model the firm can disburse cash using only one payout method: dividends or repurchase. In practice, though, most repurchasing firms are also dividend payers (see, for example, Grullon and Michaely 2002). In a more complex version of the model, where free cash has a fixed positive component, it may be possible to show that the certain component of free cash will always be paid out as dividends, and the rest will be paid out as in our model, consistent with this evidence.[23] This is also consistent with the findings that firms tend to pay permanent components of free cash with dividends

[22] Desai, Foley and Hines (2007) provide evidence that American conglomerates use dividends to avoid the agency costs of free cash in their foreign affiliations where property rights are weak. Furthermore, in countries with poor governance, ownership is concentrated (e.g., La Porta Lopez-De Silanes, Shleifer and Vishney 1999), suggesting that insiders rather than outsiders are in control.

[23] Intuitively, payout of certain free cash never results in shaving of investment. With an open-market program, however, insiders can either waste this certain cash or use it for repurchase, in which case they have trading gains at the expense of the outsiders.

and transitory components of free cash with repurchases (see, for example, Jagannathan et al. 2000, Guay and Harford 2000, Lee and Rui 2007, and Lee and Suh 2011). In Section 5 (Extension), subsection 5.2 about special dividends includes a preliminary analysis in this direction.

5 Extension

5.1 Insiders in control

When insiders are in control their choice of payout policy depends on their wealth under each policy rather than the wealth of the outsiders. However, given their choice of payout policy, the wealth terms of all agents (insiders, outsiders and the market maker) are unchanged, and hence, given a choice of payout policy the strategies of all agents are unchanged. Consequently, the conditions for the existence of a repurchase equilibrium are unchanged (Lemmas 1–4 are unchanged.) To find the resulting equilibrium, it is thus enough to compare the wealth terms of the inside shareholders under each policy. Insiders' wealth, depending on the payout policy, is as follows

With no payout:

$$\beta p_{NA} + \gamma \frac{c}{2} = \beta \alpha \left(1 - \frac{c}{2}\right) + \gamma \frac{c}{2} \tag{28}$$

With a dividend of c:

$$\beta \left(\alpha \left(1 - c\right) + c\right) \tag{29}$$

With a repurchase program (in a repurchase equilibrium):

$$\beta E[p_2] + \gamma \frac{c}{4} \tag{30}$$

Note the differences between these terms and the wealth terms of outside shareholders (24)–(26). In the case of no payout, the term $(1 - \beta)$ is replaced by β and benefits from waste $\gamma \frac{c}{2}$ are added. In the case of dividend the only difference is that the term $(1 - \beta)$ is replaced by β. In the case of repurchase, the term $(1 - \beta)$ is replaced by β, benefits from waste are $\gamma \frac{c}{4}$, reflecting incomplete waste prevention, and there is no term for trading losses because insiders do not trade their own shares at $t = 1$.

Proposition 1 still holds when insiders are in control; however it does not dictate insiders' choice between dividend and no payout because insiders have private benefits from waste.

Comparing the wealth terms (28) and (29) insiders prefer dividend over no payout if

$$\beta\alpha\left(1-\frac{c}{2}\right)+\gamma\frac{c}{2}<\beta\left(\alpha\left(1-c\right)+c\right)$$

or

$$\gamma\frac{c}{2}<\beta c\left[1-\frac{\alpha}{2}\right]$$

This condition is more restrictive than the condition $\alpha < 2$ set by the outside shareholders. That is, the expected return above which insiders prefer no payout over dividend is lower than that set by outside shareholders. This is in turn because when insiders chose to pay out dividends, they give up benefits from waste. Comparing the wealth terms (28) and (30), insiders prefer repurchase over no payout if

$$\beta p_{NA}+\gamma\frac{c}{2}<\beta E[p_2]+\gamma\frac{c}{4}$$

which can be rearranged using (42) to the RHS of (19), which always holds in a repurchase equilibrium according to Lemma 3. Thus, Proposition 2 also holds when insiders are in control. That is, whenever a repurchase equilibrium exists insiders will prefer to announce a repurchase over no payout.

Last, compare the wealth terms of insiders (29) and (30) to the wealth terms of outsiders (25) and (26). With dividends insiders get the same as outsiders (after factoring by ownership $\beta/(1-\beta)$). However, with repurchase in comparison to outsiders, insiders have benefits from waste $\gamma\frac{c}{4}$ while they do not have trading losses $q\left(E[p_2]-p\right)$. Thus, when both dividends and repurchases are feasible, insiders are more likely to prefer a repurchase over dividend in comparison to outsiders. To conclude, when insiders are in control, other things being equal, one can expect less dividend payout and more repurchase payouts.

5.1.1 Insiders announcing after observing realization

In our setup, the payout method decision has no signaling effect because it is made *before* insiders observe the realized outcome. If insiders are in control and can choose the distribution method *after* observing the realized outcome (i.e. at $t = 1$) then this choice may signal. We now shortly report the results under such an alternative set up in which insiders are in control and make a payout decision *after* observing the realized outcome. In this setup the insiders need to announce a dividend, a repurchase or not announce at $t = 1$. A dividend is paid once announced at $t = 1$ and following an announcement of repurchase the firm can repurchase or not.

If the state realized at $t = 1$ is BL or BH all cash is tied to investment and insiders cannot pay a divided. A dividend can thus be announced only in the states SH, SL. In the states BL and BH, the insiders cannot execute a repurchase either. They can announce a repurchase and not execute it in these states, but they have no incentive to do so. This is because if they do not execute, their wealth is not affected by the price p that the market maker sets at $t = 1$ given their strategy; at the same time, because they do not actually repurchase, the terminal share value is also not affected by the price p as the firm does not buy at $t = 1$. If the insiders' strategy is to announce in all states, then the announcement is not revealing and this becomes like the case of announcing at $t = 0$ analyzed above. If the insider's strategy is to announce only in one of the states SH, or SL, the announcement is revealing so there is no incentive to announce. Consequently, we can limit the analysis to only two repurchase strategies:

a) Announce only in states SL, SH and repurchase in both states.

b) Announce only in states SL, SH and repurchase only in state SH (insiders will never announce and repurchase only in state SL).

Consider the payoffs to insiders under the different distribution strategies

With no payout insiders get $\beta\alpha_i(1 - c) + \gamma c$

With dividend insiders get $\beta\alpha_i(1 - c) + \beta c$

With a repurchase they get $\beta[\alpha_i(1 - c)/(1 - c/p)]$

where $i = 1, 2$, in the states SL, SH, respectively.

The resulting equilibrium payout decision depends on the ratio β/γ as follows[24]

a) If $\beta/\gamma < \alpha/(\alpha + \sigma)$ no payout

b) If $\alpha/(\alpha + \sigma) < \beta/\gamma < 1$ repurchase announcement with actual repurchase in state SH only if condition (20) holds; no payout otherwise.

c) If $1 < \beta/\gamma < \alpha/(\alpha - \sigma)$ repurchase announcement with actual repurchase in state SH only if condition (20) holds; dividend otherwise.

d) If $\alpha/(\alpha - \sigma) < \beta/\gamma$ either a dividend or repurchase announcement with actual repurchase in states SL and SH (the firm is indifferent).

Thus, in this alternative setup both dividends and repurchases, when announced, signal that the investment opportunity is small and hence result in a price drop (lower p). This prediction counters the empirical evidence. However, it is possible that the results here are influential also in practice, but are dominated by other forces that are outside our model. For example, the common interpretation of the empirical announcement return is that by the time the payout is announced, the decrease in investment opportunity is publicly known and the

[24] The proof is available from the author upon request.

payout signals cash waste prevention and future increases in cash flow (which are outside our model).

5.2 Special dividends

In this subsection we consider incorporating special dividends into the model. Empirically, special dividends are relatively rare and large dividends. They are often paid in relation to a capital structure change, such as a leveraging up transaction, or following a cash windfall. Typically, a large sum of cash that is clearly not required for operations is disbursed. Special dividends tend to be a one-time payout and are not paid as part of the firm's ongoing payout policy.

One simple way to incorporate special dividends into the model is to assume that at $t = 0$, it is publicly known that part of the cash endowment will never be needed for investment, that is, it is surely free. Under this setup, outsiders will demand that the surely free portion of the cash endowment be paid out at $t = 0$ (pay a special dividend). This is because removing this cash will never result in future investment shaving. If not removed, at $t = 0$, it will either be wasted by the insiders or used by them to repurchase for trading gains at the expense of outside shareholders. For the outsiders, preventing the waste of this surely free cash with a special dividend at $t = 0$ will always dominate letting the insiders waste or repurchase. Under this setup, it is immediate to show that special dividends will be used to distribute at $t = 0$ all cash that is known to be free already at $t = 0$. The rest of the endowment will be treated as in the main analysis of the paper (regular dividend, repurchase, or no payout).

Another less trivial way to incorporate special dividends is to assume that at $t = 1$ the outsiders observe with probability φ the realized investment size (equivalently, they observe if the level of free cash is c or 0), and can intervene at that time and force a "special dividend." This will thus be an "unplanned" dividend, consistent with the empirical evidence. If $\varphi = 1$, there is no need for outsiders to announce a dividend or repurchase at $t = 0$ because they can always disburse all free cash at $t = 1$ (there is no information asymmetry and we are in an M&M world). If, instead, $\varphi = 0$, we are back in our general setup. The interesting setup is, of course, when $\varphi \in (0, 1)$. As in the main analysis of the paper, consider first the choice between announcing a (regular) dividend at $t = 0$ and no payout, when special dividends at $t = 0$ are possible. Recall that without the option of special dividends the decision rule was to pay a regular dividend if expected return on investment $\alpha < 2$, and have no payout otherwise. Now, when special dividends at $t = 1$ are possible, the level of α under which outsiders will prefer to announce a regular dividend at $t = 0$ is lower. This is because with no dividend they may still be able to prevent the waste at $t = 1$ a fraction φ of the time. It is simple to show that for $0 < \varphi < 1$, the outsiders will prefer a regular dividend at $t = 0$ if $\alpha < 2 - \varphi$ and pay no regular regular dividend otherwise. The higher the probability that outsiders observe the investment size at $t = 1$ the less likely they are to announce a regular dividend at $t = 0$, and the more likely we are to observe special dividends.

Next consider the outsider shareholders' choice between a repurchase announcement at $t = 0$ and no payout when special dividends at $t = 1$ are possible. Without a repurchase announcement, in the states SL and SH outsiders observe free cash φ of the time, demand a special dividend, and thereby prevent the waste of free cash. But, free cash is still wasted in these states in the remaining $1 - \varphi$ of the time. With a repurchase announcement, again, in states SL and SH outsiders observe the free cash and force a special dividend φ of the time. Consequently, there will be no waste, no actual repurchase, and the market maker will set $p = p_{NA}$. But, in the remaining $1-\varphi$ of the time, only the firm (insiders) observes the state realized when free cash is available, there is no special dividend, and the market maker condition is exactly the same as in the main analysis. As a result, Lemmas 1 through 4 and Proposition 2 are unchanged: the $t = 1$ price p is the same, the conditions for repurchase equilibrium are exactly the same, and whenever repurchase equilibrium is possible, a repurchase announcement will dominate no payout.

Lastly, consider the outsiders' choice among regular dividends, repurchase, and no payout, when special dividends at $t = 1$ are possible. Relative to the setup in which no special dividends are possible (the paper's main analysis), as stated above, the expected payoff to outsiders with regular dividend is unchanged. However, their expected payoff with no payout announcement at $t = 0$ when special dividends are possible, is higher. This is because in the states SL and SH, now φ of the time they prevent the waste. Outsiders expected payoff with a repurchase announcement relative to the setup with no special dividends is also higher. This is because when the state is SL they prevent the waste φ of the time, and when the state is SH they prevent the waste φ of the time without trading losses to the insiders. Consequently there are now two changes resulting in Proposition 3. First, a regular dividend is possible only for $\alpha < 2-\varphi$ (instead of $\alpha < 2$). But also, α_R, the expected return on investment above which a repurchase announcement is preferred over dividend announcement, will be lower. Again, this is because, other things being equal, when special dividends are possible, the expected payoff to outsiders under repurchase announcement is higher than when special dividends are not possible, while the expected payoff to outsiders under regular dividends is the same with or without the option for special dividends.

Overall, incorporating special dividends into the model in this manner will result in less regular dividends and more repurchase announcements. This is consistent with the empirical findings that regular dividends and special dividends are substitutes and that repurchases and special dividends are not (e.g. DeAngelo et al. 2000).

6 Conclusion

This paper builds on the agency costs of free cash to explain how firms determine their payout policy. Our results suggest that dividends eliminate the agency costs of free cash by forcing cash out, but could result in underinvestment if the cash paid out is later needed for operations. Open-market programs avoid the underinvestment problem by leaving insiders the option to cancel the payout. Instead, they stimulate payout by providing trading gains to these better informed insiders at the expense of the general shareholders. Because their execution is optional, open-market programs cannot always prevent the waste of free cash. Payout policy is thus determined as a trade-off between eliminating agency problems (with dividends) and preserving financial flexibility (with open-market programs). Our model predicts that higher expected return on investment and higher uncertainty of return on investment will be associated with repurchases more than with dividends, while higher uncertainty about the level of free cash and more severe agency problems will be associated with dividends more than with repurchases. These predictions are broadly consistent with the empirical evidence.

7 Appendix - Proofs of Lemmas and Propositions

Proof of Proposition 1: Maximizing (1) over d is equivalent to minimizing

$$(\alpha - 1)d + \bar{\alpha}\frac{(c-d)^{+}}{2}. \tag{31}$$

The function (31) is piecewise linear in d on the segments $\{(0,c), (c,1)\}$. In order to optimize the dividend level, it is thus enough to compare the value of (31) at the extreme points $D \in \{0, c, 1\}$. If $d = 0$, the value of (31) is

$$\alpha\frac{c}{2}. \tag{32}$$

If $d = 1$, the value of (31) is

$$(\alpha - 1). \tag{33}$$

If $d = c$ the value of (31) is

$$(\alpha - 1)c \tag{34}$$

which is always lower (better) than (33). Thus, optimization implies choosing $d = c$ or $d = 0$ depending on whether or not

$$(\alpha - 1)c < \alpha\frac{c}{2}$$

which can be rearranged to

$$\left(\frac{\alpha}{2} - 1\right) < 0 \tag{35}$$

and implies choosing $d = c$ if $\alpha < 2$ and choosing $d = 0$ otherwise.■

Proof of Lemma 1: For part (i) of the lemma, suppose $p > E[p_2]$. Given that the market maker sets p to break even, it means, there is a state where the firm is buying overpriced shares. but under the assumption $\beta < \gamma$, insiders are not willing to tolerate trading losses. Therefore $p > E[p_2]$ is not a sustainable equilibrium outcome.

For part (ii) of the lemma, we will show that if the firm buys in both states $\{SL, SH\}$ the condition $p \leq E[p_2]$ cannot hold. Suppose that the firm repurchases in both states $\{SL, SH\}$. Then the market maker condition is

$$(\frac{\alpha_1(1-c)}{1-\frac{c}{p}} - p)\left(q - \frac{c}{p}\right) + (\alpha_1 - p)q + (\frac{\alpha_2(1-c)}{1-\frac{c}{p}} - p)\left(q - \frac{c}{p}\right) + (\alpha_2 - p)q = 0 \tag{36}$$

which can be rearranged to

$$(E[p_2] - p) - \frac{c}{4qp}\left((\frac{\alpha_1(1-c)}{1-\frac{c}{p}} - p) + (\frac{\alpha_2(1-c)}{1-\frac{c}{p}} - p)\right) = 0.$$

Suppose that $p \leq E[p_2]$. Then it must be the case that

$$(p - \frac{\alpha_1(1-c)}{1-\frac{c}{p}})\frac{c}{p} + (p - \frac{\alpha_2(1-c)}{1-\frac{c}{p}})\frac{c}{p} \leq 0$$

or

$$p \leq \frac{\alpha_1 + \alpha_2}{2}(1-c) + c = \alpha(1-c) + c. \tag{37}$$

Solving the market condition (36) for the price p and substitution into (37) yields

$$p = \frac{p_{NA} + \frac{1+2q}{2q}c + \sqrt{\left(p_{NA} + \frac{1+2q}{2q}c\right)^2 - c\left(2\alpha + (2c + 2\alpha(1-c))\frac{1}{q}\right)}}{2} \leq \alpha(1-c) + c$$

where p_{NA} is given in (4). Upon rearrangement

$$p_{NA}+\frac{1+2q}{2q}c+\sqrt{\left(p_{NA}+\frac{1+2q}{2q}c\right)^{2}-c\left(2\alpha+\left(2c+2\alpha\left(1-c\right)\right)\frac{1}{q}\right)}\leq 2\left(\alpha\left(1-c\right)+c\right)$$

which can be further rearranged (by squaring each positive side of the quadratic inequality) to

$$-c\left(2\alpha+\left(2c+2\alpha\left(1-c\right)\right)\frac{1}{q}\right)\leq 4\left(\alpha\left(1-c\right)+c\right)^{2}-2\left(2\alpha\left(1-c\right)+2c\right)\left(p_{NA}+\frac{1+2q}{2q}c\right)$$

or

$$c\left(2\alpha-4\alpha c+4c\right)\leq 4\left(\alpha\left(1-c\right)+c\right)^{2}-4p_{NA}\left(\alpha\left(1-c\right)+c\right).$$

Substituting p_{NA} using (4) and further rearranging, we can write this as

$$2c\left(2\alpha-4\alpha c+4c\right)\leq\left(2\alpha\left(1-c\right)+2c\right)\left[4\left(\alpha\left(1-c\right)+c\right)-\left(4\left(\alpha\left(1-c\right)\right)+\alpha c\right)\right]$$

which boils down to $\alpha\leq 1$, which never holds, since by assumption $1<\alpha_1=\alpha-\sigma$. Thus, our conjecture $p\leq E[p_2]$ is wrong. Hence, whenever the firm repurchases in both states $\{SL,SH\}$ the market maker condition implies that $p>E[p_2]$ which can never hold in equilibrium. Now since the stock value is higher in state $\{SH\}$ than in state $\{SL\}$, a firm that repurchases in the state $\{SL\}$ will always repurchase in the state $\{SH\}$. Thus, in any equilibrium the firm will repurchase only in the state $\{SH\}$ if at all.■

Proof of Lemma 2: Part (i) - The market maker condition (15) can be rearranged to

$$p^{2}-\left(p_{NA}+c\frac{1+4q}{4q}\right)p+cp_{NA}-\frac{\alpha_{2}(1-c)}{4}c+(c+\alpha_{2}(1-c))\frac{c}{4q}=0.$$

where $p_{NA}=\frac{\alpha}{2}(2-c)$. The solution of this quadratic equation is

$$p=\frac{p_{NA}+c\frac{1+4q}{4q}\pm\sqrt{(p_{NA}+c\frac{1+4q}{4q})^{2}-4c\left(p_{NA}-\frac{\alpha_{2}(1-c)}{4}+\left(c+\alpha_{2}\left(1-c\right)\right)\frac{1}{4q}\right)}}{2}.$$

which can be rearranged to

$$p=\frac{p_{NA}+c\frac{1+4q}{4q}\pm\sqrt{(p_{NA}+c\frac{1+4q}{4q})^{2}-c\left(4p_{NA}+c\frac{1}{q}+\left(\alpha+\sigma\right)\left(1-c\right)\frac{1-q}{q}\right)}}{2}. \tag{38}$$

Only the positive solution in (38) is feasible, which is (16).

Part (ii) - The market maker condition (15) can be rearranged to

$$(E[p_2] - p) - \frac{c}{4qp}(\frac{\alpha_2 (1-c)}{1-\frac{c}{p}} - p) = 0.$$

From Lemma 1, in any equilibrium with a repurchase announcement $p < E[p_2]$, which by inspection is thus equivalent to

$$p < \frac{\alpha_2 (1-c)}{1-\frac{c}{p}}$$

which can be further rearranged to (17).

Part (iii) - Substituting (16) into (17) yields

$$\frac{p_{NA} + c\frac{1+4q}{4q} + \sqrt{(p_{NA} + c\frac{1+4q}{4q})^2 - c\left(4p_{NA} + c\frac{1}{q} + \alpha_2 (1-c)\left(\frac{1}{q} - 1\right)\right)}}{2} < \alpha_2 (1-c) + c$$

where p_{NA} is from (4). Upon rearrangement

$$p_{NA} + c\frac{1+4q}{4q} + \sqrt{(p_{NA} + c\frac{1+4q}{4q})^2 - c\left(4p_{NA} + \frac{c}{q} + \alpha_2 (1-c)\frac{1-q}{q}\right)} < 2(\alpha_2 (1-c) + c)$$

which can be further rearranged to

$$-c\left(4p_{NA} + \frac{c}{q} + \alpha_2 (1-c)\frac{1-q}{q}\right) < 4(\alpha_2 (1-c) + c)^2 - (\alpha_2 (1-c) + c)\left(4p_{NA} + c\frac{1+4q}{q}\right)$$

and further rearranged to

$$c[4(\alpha_2 (1-c) + c) - 4p_{NA} + \alpha_2 (1-c)] < 4(\alpha_2 (1-c) + c)^2 - (\alpha_2 (1-c) + c) 4p_{NA}$$

which is

$$4p_{NA} - 4\alpha_2 (1-c) < 3c.$$

Substituting p_{NA} using (4) this becomes

$$(3\alpha_2 - \alpha_1 - 3) c < 2(\alpha_2 - \alpha_1)$$

which upon substitution of $\alpha_1 = \alpha + \sigma$ and $\alpha_2 = \alpha + \sigma$ can be rearranged to (18).■

Proof of Lemma 3: Given that the state realized is $\{SH\}$, the insiders will execute the repurchase only if the terminal value of their shares with a repurchase is higher than the terminal value of their shares without it. That is, the firm (insider) participation condition is

$$\beta\alpha_2(1-c)+\gamma c \leq \beta\frac{\alpha_2(1-c)}{1-\frac{c}{p}}.$$

as demonstrated in subsection 3.2.1 in (6). This condition can be rearranged to

$$p \leq \frac{\beta}{\gamma}(\alpha+\sigma)(1-c)+c. \tag{39}$$

On the other hand, for a repurchase equilibrium to exist, Lemma 2 requires that the insiders must not repurchase in the state $\{LS\}$. That is, in any equilibrium with a repurchase announcement

$$\beta\frac{\alpha_1(1-c)}{1-\frac{c}{p}} < \beta\alpha_1(1-c)+\gamma c$$

After rearrangement, this condition can be written as

$$\frac{\beta}{\gamma}(\alpha-\sigma)(1-c)+c<p. \tag{40}$$

We can combine conditions (39) and (40) to summarize the restrictions on insider participation as (19).■

Proof of Lemma 4: Condition (17) is binding if and only if $\frac{\beta}{\gamma}<1$. Otherwise, condition (39) is binding. Combining these conditions yields (20).■

Proof of Proposition 2: Write the market maker condition (15) as

$$E[p_2]-p-\frac{c}{4qp}\left(\frac{\alpha_2\,(1-c)}{1-\frac{c}{p}}-p\right)=0$$

and rearrange to

$$E[p_2]-p=\frac{1}{4}\frac{c}{q}\left(\frac{\alpha_2\,(1-c)}{p-c}-1\right). \tag{41}$$

Using (4) and (22), write

$$
\begin{aligned}
E[p_2] - p_{NA} &= \frac{1}{4}\left(\alpha_1(2-c) + \alpha_2\left(\frac{1-c}{1-\frac{c}{p}} + 1\right)\right) - \frac{1}{4}(\alpha_1 + \alpha_2)(2-c) \\
&= \frac{1}{4}\alpha_2(1-c)\left(\frac{p}{p-c} - 1\right) = \frac{1}{4}\alpha_2(1-c)\frac{c}{p-c}
\end{aligned}
$$

or

$$E[p_2] - p_{NA} = \frac{1}{4}\alpha_2(1-c)\frac{c}{p-c}. \tag{42}$$

A repurchase dominates no payout if condition (23) holds. Upon substitution of $E[p_2]-p$ and $E[p_2] - p_{NA}$ from (41) and (42), respectively, condition (23) becomes

$$q\left(\frac{1}{4}\frac{c}{q}\left(\frac{\alpha_2(1-c)}{p-c} - 1\right)\right) < (1-\beta)\left(\frac{1}{4}\alpha_2(1-c)\frac{c}{p-c}\right)$$

which can be rearranged to

$$\beta\alpha_2(1-c) + c < p. \tag{43}$$

Because $\beta < 1$, it is enough to show that

$$\alpha_2(1-c) + c < p.$$

Upon substitution of p from (16) and rearrangement, this condition becomes

$$(\alpha + \sigma)(1-c) < 2\alpha\left(1 - \frac{c}{2}\right) + \frac{c}{2}$$

which always holds since by assumption $\sigma < \alpha$.■

Proof of Proposition 3: Given that a repurchase dominates no payout and that in the range $\alpha > 2$ no payout dominates a dividend, we only need to consider the range $\alpha < 2$. For outside shareholders to favor repurchase over a dividend, we have from (27) that

$$(1-\beta)c\left(1 - \frac{\alpha}{2}\right) < (1-\beta)(E[p_2] - p_{NA}) - q(E[p_2] - p)$$

or

$$q(E[p_2] - p) < (1-\beta)\left(E[p_2] - p_{NA} - c\left(1 - \frac{\alpha}{2}\right)\right).$$

Using (41) and (42) from the proof of Proposition 2 to substitute for $E[p_2]-p$ and $E[p_2]-p_{NA}$, respectively, this condition can be written as

$$q\frac{1}{q}\frac{1}{4}c\frac{c+(\alpha+\sigma)(1-c)-p}{p-c}<(1-\beta)\left(\frac{1}{4}(\alpha+\sigma)(1-c)\frac{c}{p-c}-c\left(1-\frac{\alpha}{2}\right)\right)$$

or

$$\frac{c+(\alpha+\sigma)(1-c)-p}{p-c}<(1-\beta)\left((\alpha+\sigma)\frac{1-c}{p-c}-(4-2\alpha)\right).$$

Upon rearrangement

$$(3-2\alpha-4\beta+2\alpha\beta)(p-c)+\beta(\alpha+\sigma)(1-c)<0$$

which can be further rearranged to

$$[(1-\beta)(4-2\alpha)-1](p-c)+\beta(\alpha+\sigma)(1-c)<0. \quad (44)$$

There are two ranges to consider. If $(1-\beta)(4-2\alpha)>1$, which is equivalent to

$$1<\alpha<2-\frac{1}{2(1-\beta)}, \quad (45)$$

the condition (44) becomes

$$p<\frac{\beta(\alpha+\sigma)(1-c)}{1-(1-\beta)(4-2\alpha)}+c$$

which never holds since the right-hand side is negative in the range (45). If, instead, $(1-\beta)(4-2\alpha)<1$, which is equivalent to

$$2-\frac{1}{2(1-\beta)}<\alpha<2, \quad (46)$$

the condition (44) becomes

$$\frac{\beta(\alpha+\sigma)(1-c)}{1-(1-\beta)(4-2\alpha)}+c<p. \quad (47)$$

Consider the range (46), if $\alpha=2-\frac{1}{2(1-\beta)}$, condition (47) becomes

$$(\alpha+\sigma)(1-c)+c<p$$

which by Lemma 3 never holds. Alternatively if $\alpha=2$, (47) becomes

$$\beta(\alpha+\sigma)(1-c)+c<p$$

which as shown in the proof of Proposition 2 always holds. Since in the range (46) both sides of (47) are increasing in α, there exists α_R in the range (46) below which a dividend dominates a repurchase and above which a repurchase dominates a dividend.■

References

Agrawal, A., Narayan, J., 1994. The dividend policies of all-equity firms: A direct test of the free cash flow theory. Managerial and Decision Economics 15, 139-148.

Aharony, J., Swary, I., 1980. Quarterly dividend and earnings announcements and stockholders' returns: An empirical analysis. Journal of Finance 35, 1–12.

Allen, F., Bernardo, A., Welch, I., 2000. A theory of dividends based on tax clientele. Journal of Finance 55, 2499–2536.

Almeida, H., Campello, M., Weisbach M., 2004. The cash flow sensitivity of cash. Journal of Finance 59, 993–1018.

Babenko, I., Tserlukevich, Y.,Vedrashko, A., 2012. The credibility of open market share repurchase signaling. Journal of Financial and Quantitative Analysis 47, 1059-1088.

Babenko, I., Tserlukevich, Y., Wan, P., 2012. Agency implications of equity market timing. working paper.

Banyi, M., Dyl, E., Kahle, K., 2008. Errors in estimating share repurchases. Journal of Corporate Finance 14, 460-474.

Barclay, M., Smith, C., 1988. Corporate payout policy: Cash dividend vs. open market repurchases. Journal of Financial Economics 22, 61–82.

Bertrand, M., Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preferences. Journal of Political Economy 11, 1043–1075.

Black, F., 1976. The dividend puzzle. Journal of Portfolio Management 2, 5–8.

Bonaime, A., Hankins, K., Harford, J., 2011. Financial flexibility, risk management and payout choice. Review of Financial Studies, 27, 1074–1101.

Bond, P., Zhong, H., 2016. Buying high and selling low: Stock repurchases and persistent asymmetric information. Review of Financial Studies 29, 1409-1452.

Boudoukh, J., Michaely, R., Richardson, M., Roberts, M., 2007. On the importance of measuring payout yield: Implications for empirical asset pricing. Journal of Finance 62, 877–916.

Brav, A., Graham, J., Harvey, C., Michaely, R., 2005. Payout policy in the 21st century. Journal of Financial Economics 77, 483–527.

Brennan, M., Thakor, A., 1990. Shareholder preferences and dividend policy. Journal of Finance 45, 993–1018.

Buffa, A., Nicodano, G., 2008. Should insider trading be prohibited when share repurchases are allowed? Review of Finance 12, 735–765.

Chakraborty, A., Yilmaz, N., 2011. Adverse selection and convertible bonds. Review of Economic Studies 78, 148-175.

Chay, J., Suh, J., 2009. Payout policy and cash flow uncertainty. Journal of Financial Economics 93, 88–107.

Chowdhry, B., Nanda, V., 1994. Repurchase premia as a reason for dividends: A dynamic model of corporate payout policies. Review of Financial Studies 7, 321–350.

Comment, R., Jarrell, G., 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.

DeAngelo, H., DeAngelo, L., Skinner, D., 2000. Special dividends and the evolution of dividend signaling. Journal of Financial Economics 57, 309–354.

DeAngelo, H., DeAngelo, L., Skinner, D., 2004. Are dividends disappearing? Dividend concentration and the consolidation of earnings. Journal of Financial Economics, 72, 425–456.

Decamps J., Mariotti, T., Rochet, J., Villeneuve, S., 2011. Free cash flow, issuance costs, and stock prices. Journal of Finance 66, 1501-1544.

Desai, M., Foley, F., Hines, 2007, J., Dividend policy inside the multinational firm. Financial Management 36, 5-26.

Dittmar, A., Dittmar, R., 2008. The timing of financing decisions: An examinatino of the correlation in financing waves. Journal of Financial Economics, 90, 59-83.

Eastbrook, F., 1984. Two agency-cost explanations of dividends. American Economic Review 74, 650–659.

Fama, E., French, K., 2002. Testing tradeoff and pecking order predictions about dividends and debt. Review of Financial Studies 15, 1–37.

Farre-Mensa, J., Michaely R., Schmalz M., 2014. Payout policy. Annual Review of Financial Economics 6, 75-134.

Ginglinger, E., Hamon, J., 2007. Actual share repurchases, timing and liquidity. Journal of Banking and Finance 31, 915–938.

Glosten, L., Milgrom, P., 1985. Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. Journal of Financial Economics 14, 71–100.

Gottesman, A., Jacoby, G. 2006. Payout policy, taxes and the relation between returns and the bid-ask spread. Journal of Banking and Finance 30, 37-58.

Grullon, G., Michaely, R., 2002. Dividends, share repurchases, and the substitution hypothesis. Journal of Finance 57, 1649–1684.

Grullon, G., Michaely, R., Swimanathan, B., 2002. Are dividend changes a sign of firm maturity? Journal of Business, 75, 387–424.

Grullon, G., Michaely, R., 2004. The information content of share repurchase programs. Journal of Finance 59, 651–680.

Guay, W., Harford, J., 2000. The cash-flow permanence and information content of dividend increases versus repurchases. Journal of Financial Economics 57, 385–415.

Guttman, I., Kadan, O., Kandel, E., 2010. Dividend stickiness and strategic pooling," Review of Financial Studies 23, 4455-4495.

Hao, Q., 2016. Is there information leakage prior to share repurchase announcements? Evidence from daily options trading. Journal of Financial Markets 27, 79-101.

Healy P., Palepu K., 1988. Earnings information conveyed by dividend initiations and omissions. Journal of Financial Economics 21, 149-175.

Huang S., Thakor, A., 2013. Investor heterogeneity, investor-management disagreement, and open-market share repurchases. Review of Financial Studies 26, 2453-2491.

Ikenberry, D., Lakonishok, J., Vermaelen, T., 2000. Stock repurchases in Canada: Performance and strategic trading. Journal of Finance 55, 2373–2397.

Irvine, P., Pontiff, J., 2009. Idiosyncratic return volatility, cash flows, and product market competition. Review of Financial Studies 22, 1149-1177.

Jagannathan, M., Stephens, C., Weisbach, M., 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 takeovers. American Economic Review 76, 323–329.

Jensen, M., 2000. A Theory of the Firm, Harvard University Press.

John, K., A. Knyazeva, D. Knyazeva, 2015. Governance and payout precommitment. Journal of Corporate Finance 33, 101-117.

Kahle, K., 2002. When a buyback isn't a buyback: Open market repurchases and employee options. Journal of Financial Economics 63, 235–261.

Kumar, P., 1988, Shareholder–manager conflict and the information content of dividends. Review of Financial Studies 1, 11-136.

La Porta, R., Lopez-De Silanes, F., Shleifer, A., Vishny, R., 1999. Corporate ownership around the world. Journal of Finance 54, 471–517.

La Porta, R., Lopez-De Silanes, F., Shleifer, A., Vishny, R., 2000. Agency problems and dividend policy around the world. Journal of Finance 55, 1–33.

Lambrecht B., Myers, S., 2012. A Lintner model of dividends and managerial rents. Journal of Finance 67, 1761-1810.

Larkin, Y., Leary, M., Michaely, R., 2012. Do investors value dividend smoothing stocks differently? working paper.

Leary M., Michaely R. 2011. Determinants of dividend smoothing: Empirical evidence. Review of Financial Studies 24, 3197-3249.

Lee, B., Rui O., 2007. Time-series behavior of share repurchase and dividends. Journal of Financial and Quantitative Analysis 42, 119-142.

Lee, B., Suh, J., 2011. Cash holdings and share repurchases: International evidence. Journal of Corporate Finance 17, 1306-1329.

Lintner, J., 1956. Distribution of incomes of corporations among dividends, retained earnings, and taxes. American Economic Review 46, 97–113.

Lucas, D., McDonald, R., 1998. Shareholder heterogeneity, adverse selection and payout policy. Journal of Financial and Quantitative Analysis 33, 233–253.

McNally, W., 1999. Open market stock repurchase signaling. Financial Management 28, 55-67.

Michaely, R., Thaler, R., Womack, K., 1995. Price reaction to dividend initiations and omissions: Overreaction or drift? Journal of Finance 50, 573–608.

Miller M., Modigliani F., 1961. Dividend policy, growth, and the valuation of shares. Journal of Business 34, 411-33.

Miller, M., Rock, K., 1985. Dividend policy under asymmetric information. Journal of Finance 40, 1031–1051.

Myers, S., 2003. Financing of corporations. In: Constantinides, G., Harris, M., Stulz, R., (Eds.), Handbook of the Economics of Finance, North-Holland.

Myers, S., Majluf, N., 1984. Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics 13, 187–221.

Netter, J., Mitchell, M., 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, 289–317.

Oded, J., 2005. Why do firms announce open-market stock repurchase programs? Review of Financial Studies 18, 271–300.

Oded, J., 2009. Optimal execution of open-market stock repurchase programs. Journal of Financial Markets 12, 832–869.

Ofek, E., Yermack, D., 2000. Taking stock: Equity-based compensation and the evolution of managerial ownership. Journal of Finance 55, 1367–1384.

Ofer, R., Thakor, A., 1987. A theory of stock price responses to alternative corporate cash disbursement methods: Stock repurchases and dividends. Journal of Finance 42, 365–394.

Peyer, U., Vermaelen, T., 2009. The nature and persistence of buyback anomalies. Review of Financial Studies 22, 1693-1745.

Rau, R., Vermaelen, T., 2002. Regulation, taxes and share repurchases in the United Kingdom. Journal of Business 75, 245–282.

Rock, K., 1986. Why new issues are underpriced. Journal of Financial Economics, 15, 187–212.

Ross, S., Randolph, R. Westerfield, R., Jordan B., 2008. Fundamentals of Corporate Finance. McGraw-Hill/Irwin, New York, NY.

Shleifer, A., Vishny, R., 1997. A survey of corporate governance. Journal of Finance 52, 737–783.

Stephens, C., Weisbach, M., 1998. Actual share reacquisition in open-market repurchase programs. Journal of Finance 53, 313–333.

Stulz, R., 1990. Managerial discretion and optimal financing policies. Journal of Financial Economics 26, 2–28.

Zwiebel, J., 1996. Dynamic capital structure under managerial entrenchment. American Economic Review 86, 1197–1215.

Figure 1: Time line

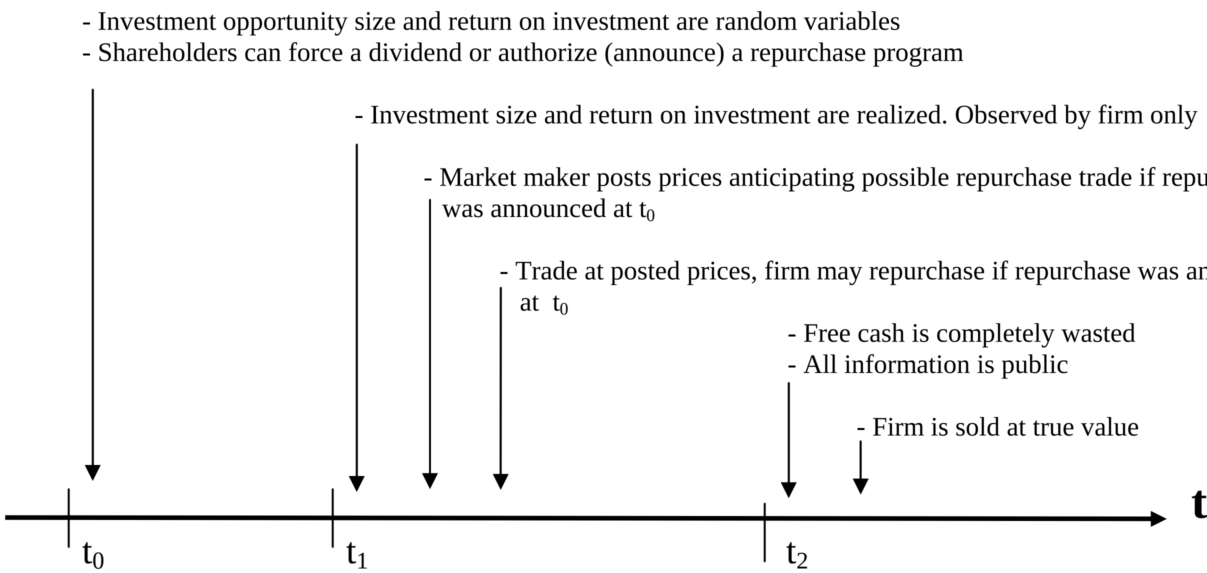

Figure 2: Feasibility of repurchase as a function of the ratio between insiders' ownership and benefits from waste β/γ. This figure demonstrates how existence of a repurchase equilibrium depends on the ratio β/γ. In the numerical example, we change the ratio β/γ in the range [0, 2.5], holding all other parameters fixed. The lower horizontal line represents the price p, and the upper horizontal line represents $E[p_2]$. Both lines are horizontal because both p and $E[p_2]$ do not vary with β/γ. Feasibility of a repurchase equilibrium requires that the no-free-riding condition $p < E[p_2]$ holds, i.e., that the line p is below the line $E[p_2]$. Under the parameter values chosen in this example the figure shows that this condition is always met.

The two diagonal lines that start at the origin represent the limits on p in the insider participation condition (10). Namely, the lower diagonal line represents the term $(\beta/\gamma)(\alpha-\sigma)(1-c)+c$ and the upper (steeper) diagonal line represents the term $(\beta/\gamma)(\alpha+\sigma)(1-c)+c$. Feasibility of repurchase equilibrium also requires that the insider participation condition (10) holds, i.e., that the line p will be between the diagonal lines. The figure indicates that for values of β/γ below 0.75, the line p is above the diagonal lines. Namely, the condition $p<(\beta/\gamma)(\alpha+\sigma)\ (1-c)+c$ does not hold. For values of β/γ in the range [0.75, 1.8], the price p is between the diagonal lines so that the firm will repurchase only in state {SH} and hence a repurchase equilibrium exists. For values of β/γ above 1.8 the line p is below the diagonal lines. Namely, the condition $p>(\beta/\gamma)(\alpha-\sigma)(1-c)+c$ does not hold and hence in this range a repurchase equilibrium cannot hold.

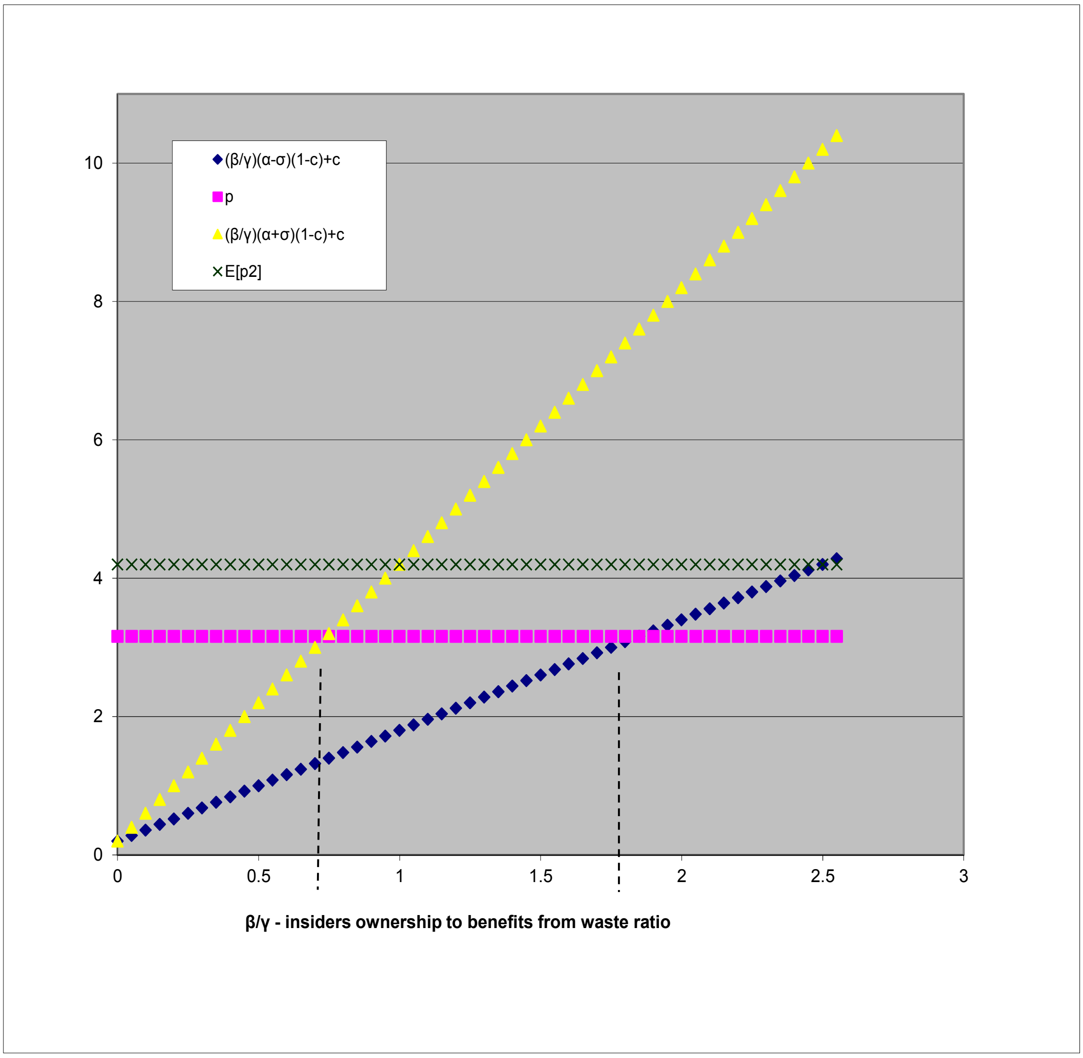

Figure 3: Feasibility of repurchase as a function of variability in free cash c. This figure demonstrates how existence of a repurchase equilibrium depends on variability in free cash c (equivalently, the variability in the size of investment opportunity). In the numerical example, we change the parameter c in the range [0, 1], holding all other parameters fixed. The lower and the upper diagonal lines that meet at c=1 represent the limits $(\beta/\gamma)(\alpha-\sigma)(1-c)+c$ and $(\beta/\gamma)(\alpha+\sigma)(1-c)+c$ in the insider participation condition (10), respectively. The concave diagonal line is $E[p_2]$, and the convex line is p. Feasibility of a repurchase equilibrium requires that the line p be below the line $E[p_2]$ and between the lines $(\beta/\gamma)(\alpha+\sigma)(1-c)+c$ and $(\beta/\gamma)(\alpha+\sigma)(1-c)+c$. The figure demonstrates that in the range $c<0.38$ repurchase is feasible. Namely, the line p is between the lines $(\beta/\gamma)(\alpha+\sigma)(1-c)+c$ and $(\beta/\gamma)(\alpha+\sigma)(1-c)+c$, and below the line $E[p_2]$. For $c>0.38$, the condition $p<(\beta/\gamma)(\alpha+\sigma)(1-c)+c$ is violated and repurchase equilibrium cannot hold. For values $c>0.6$ the condition $p<E[p_2]$ also does not hold.

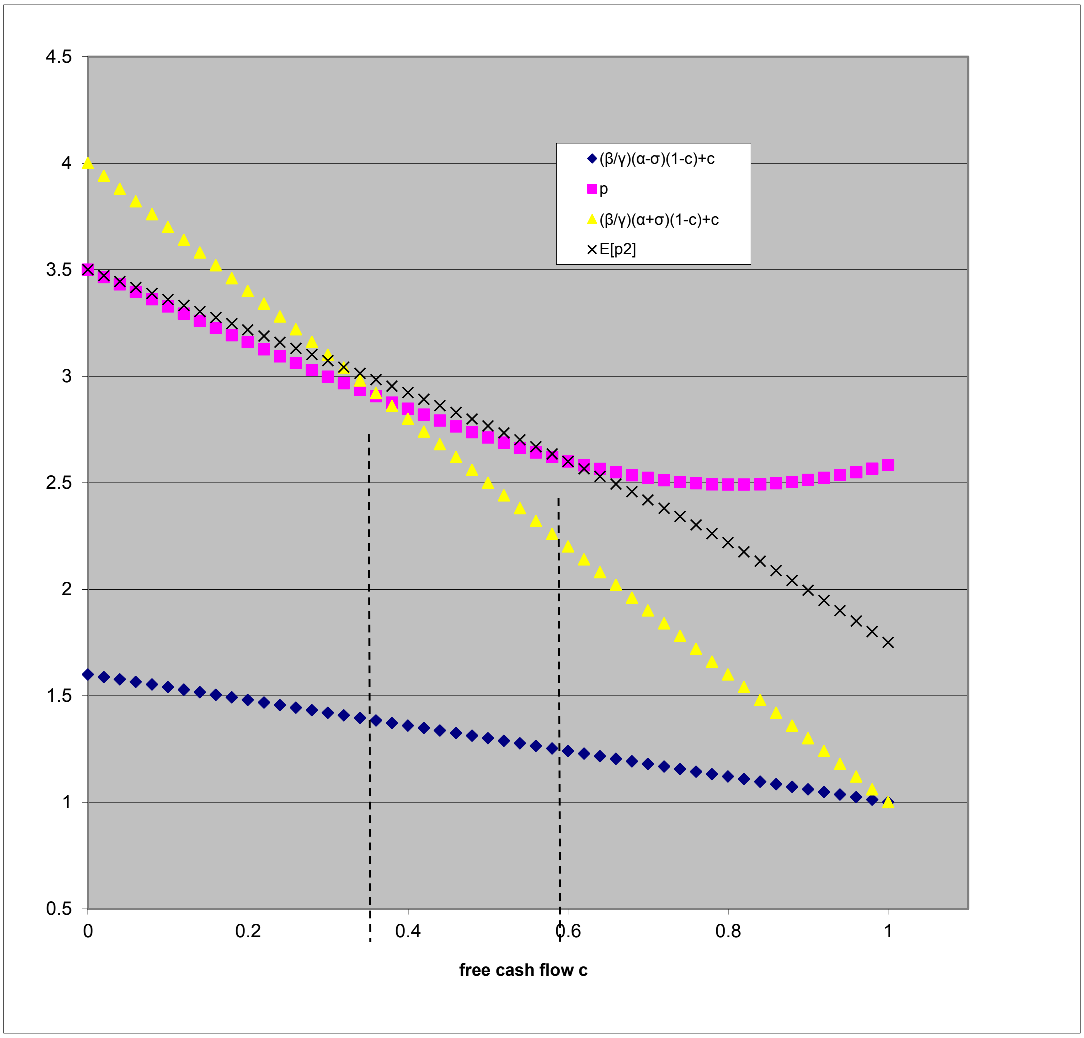

Figure 4: Feasibility of repurchase as a function of variability in return on investment σ. This figure demonstrates how existence of a repurchase equilibrium depends on variability in return on investment σ. In the numerical example, we let σ vary in the range [0, 1.5] and hold all other parameters fixed (and recall α=3.5). The downward sloping line starting from level 2.44 at σ=0 represents the term (β/γ)(α-σ)(1-c)+c in condition (10), and the upward sloping line that meets it at σ=0 represents the term (β/γ)(α+σ)(1-c)+c in condition (10). The two (relatively) horizontal lines are p (drawn using squares) and E[p2] (drawn using 'x'). Feasibility of repurchase requires that the line p be below the line $E[p_2]$ and between the lines (β/γ)(α+σ)(1-c)+c and (β/γ)(α+σ)(1-c)+c. When σ is low, a repurchase equilibrium is not feasible. Indeed the line p is above the line $E[p_2]$ and above both the lines (β/γ)(α-σ)(1-c)+c and (β/γ)(α+σ)(1-c)+c. For σ >0.25 the condition $p<E[p_2]$ holds and for σ >1.15, the condition p<(β/γ)(α+σ)(1-c)+c also holds. Thus, for σ >1.15, a repurchase is feasible.