

CORPORATE FINANCING AND INVESTMENT DECISIONS WHEN FIRMS HAVE INFORMATION THAT INVESTORS DO NOT HAVE*

Stewart C. MYERS

MIT/NBER, Cambridge, MA 02139, USA

Nicholas S. MAJLUF

Universidad Catolica de Chile, Santiago, Chile

Received August 1982, final version received February 1984

This paper considers a firm that must issue common stock to raise cash to undertake a valuable investment opportunity. Management is assumed to know more about the firm's value than potential investors. Investors interpret the firm's actions rationally. An equilibrium model of the issue–invest decision is developed under these assumptions. The model shows that firms may refuse to issue stock, and therefore may pass up valuable investment opportunities. The model suggests explanations for several aspects of corporate financing behavior, including the tendency to rely on internal sources of funds, and to prefer debt to equity if external financing is required. Extensions and applications of the model are discussed.

1. Introduction

Consider a firm that has assets in place and also a valuable real investment opportunity. However, it has to issue common shares to raise part or all of the cash required to undertake the investment project. If it does not launch the project promptly, the opportunity will evaporate. There are no taxes, transaction costs or other capital market imperfections.

Finance theory would advise this firm to evaluate the investment opportunity as if it already had plenty of cash on hand. In an efficient capital market, securities can always be sold at a fair price; the net present value of selling securities is always zero, because the cash raised exactly balances the present value of the liability created. Thus, the decision rule is: take every positive-NPV project, regardless of whether internal or external funds are used to pay for it.

*This paper draws on Majluf (1978) and an earlier (1978) joint working paper, but it has undergone several major revisions and expansions. We thank Fischer Black, George Constantinides, Roger Gordon, Rene Stulz and the referee, Harry DeAngelo, for valuable comments. The Office of Naval Research sponsored the initial work on this paper.

What if the firm's managers know more about the value of its assets and opportunities than outside investors do? As we will show, nothing fundamental is changed so long as managers invest in every project *they* know to have positive NPV. If they do this, the shares investors buy will be correctly priced *on average*, although a particular issue will be over or underpriced. The manager's inside information creates a side bet between old and new stockholders, but the equilibrium issue price is unaffected.

However, if managers have inside information there must be some cases in which that information is so favorable that management, if it acts in the interest of the *old* stockholders, will refuse to issue shares even if it means passing up a good investment opportunity. That is, the cost to old shareholders of issuing shares at a bargain price may outweigh the project's NPV. *This* possibility makes the problem interesting: investors, aware of their relative ignorance, will reason that a decision *not* to issue shares signals 'good news'. The news conveyed by an issue is bad or at least less good. This affects the price investors are willing to pay for the issue, which in turn affects the issue-invest decision.

If the firm finally decides *not* to issue and therefore *not* to invest – and we will show formally how this can happen – real capital investment is misallocated and firm value reduced. Of course, we would also expect management to try to rearrange the firm's capital structure to avoid being caught in this 'financing trap' the next time the firm has a positive-NPV investment. Thus, our analysis of how asymmetric information affects firms' issue-invest decisions may lead us to explain some corporate financing choices as attempts by firms to avoid the problems we have just introduced.

The first problem is to figure out the equilibrium share price conditional on the issue-invest decision, assuming rational investors, and also a rational firm which bases the issue-invest decision on the price it faces. This paper addresses that problem, and solves it under reasonable simplifying assumptions.

The assumptions are set out and discussed in section 2. This section also contains a numerical example. A general formulation and solution is given in section 3.

However, section 3's results raise deeper issues. Our solution assumes that management acts in the interests of 'old' (existing) stockholders. It also assumes those stockholders are *passive*, and do not adjust their portfolios in response to the firm's issue-invest decision, except possibly to buy a predetermined fraction of any new issue.

This assumption makes financing matter. A firm with ample financial slack – e.g., large holdings of cash or marketable securities, or the ability to issue default-risk-free debt – would take all positive-NPV opportunities. The same firm without slack would pass some up. Also, with this assumption about management's objective, our model predicts firms will prefer debt to equity if they need external funds.

If old shareholders are assumed to be *active*, and to rebalance their portfolios in response to what they learn from the firm's actions, then financing does *not* matter: financial slack has no impact on investment decisions. Even with ample slack, the firm will pass up some positive-NPV investments.

We can choose from three statements about management's objective under asymmetric information:

- (1) Management acts in the interests of *all* shareholders, and ignores any conflict of interest between old and new shareholders.
- (2) Management acts in old shareholders' interest, *and* assumes they are *passive*.
- (3) Management acts in old shareholders' interest, but assumes they rationally *rebalance* their portfolios as they learn from the firm's actions.

We have so far found no compelling theoretical justification for favoring any one of these statements over the other two. A theory, or at least a story, could be developed to support any one of the three statements. We will suggest some of these stories as we go along. However, we do not claim to have a theory of managerial behavior fully supporting our model. We treat the three statements as possible *assumptions* about managerial behavior. Since we cannot judge the assumptions' realism, we turn instead to their positive implications.

The three statements yield substantially different empirical predictions. Statement 2 leads at this stage of the empirical race, because it explains why stock prices fall, on average, when firms announce an equity issue. Moreover, it explains why debt issues have less price impact than stock issues. We briefly review this evidence in section 4.

A model based on (a) asymmetric information and (b) management acting in the interests of passive, old stockholders may explain several aspects of corporate behavior, including the tendency to rely on internal sources of funds and to prefer debt to equity if external financing is required. Some of the model's implications are discussed in sections 5 and 6 of the paper. We defer the customary introductory review of the literature until the end of section 2, after our assumptions have been more fully explained.

2. Assumptions and example

We assume the firm (i.e., its managers) has information that investors do not have, and that both managers and investors realize this. We take this information asymmetry as given – a fact of life. We side-step the question of how much information managers should release, except to note the underlying assumption that transmitting information is costly. Our problem disappears if managers can costlessly convey their special information to the market.

The firm has one existing asset and one opportunity requiring investment I . The investment can be financed by issuing stock, drawing down the firm's cash balance or selling marketable securities. The sum of cash on hand and marketable securities will be referred to as *financial slack* (S).

Financial slack should also include the amount of default-risk-free debt the firm can issue. (Discussion of risky debt is deferred to section 3.) However, it's simpler for our purposes to let the firm use risk-free borrowing to reduce the required investment I . We thus interpret I as required *equity* investment.

The investment opportunity evaporates if the firm does not go ahead at time $t = 0$. (We could just as well say that delay of investment reduces the project's net present value.) If $S < I$, going ahead requires a stock issue of $E = I - S$. Also, the project is 'all or nothing' – the firm can't take part of it.

We assume capital markets are perfect and efficient with respect to publicly available information. There are no transaction costs in issuing stock. We also assume that market value of the firm's shares equals their expected future value conditional on whatever information the market has. The future values could be discounted for the time value of money without changing anything essential.¹ Discounting for risk is not considered, because the only uncertainty important in this problem stems from managers' special information. Investors at time $t = 0$ do not know whether the firm's stock price will go up or down when that special information is revealed at $t = 1$. However, the risk is assumed to be diversifiable.²

We can now give a detailed statement of who knows what when.

2.1. A three-date model

(1) There are three dates, $t = -1, 0$ and $+1$. At $t = -1$, the market has the same information the management does. At $t = 0$, management receives additional information about the value of the firm's asset-in-place and investment opportunity, and updates their values accordingly. The market does not receive this information until $t = +1$.

(2) The value of the asset-in-place at $t = -1$ is the expected future value $\bar{A} = E(\tilde{A})$; the distribution of \tilde{A} represents the asset's possible (updated) values at $t = 0$. Management's updated estimate at $t = 0$ is a , the realization of \tilde{A} .³

(3) The net present value (NPV) at $t = -1$ of the investment opportunity is $\bar{B} = E(\tilde{B})$. The distribution of \tilde{B} represents the asset's possible updated

¹We could interpret our time subscript not as calendar time, but just the state of information available to the firm and market.

²That is, managers may have inside information about the firm, but not about the market or the economy.

³An analogy may help make this clear. Think of a share of IBM stock on January 1 ($t = -1$). \tilde{A} could be the unknown distribution of the February 1 price, a the actual price on February 1 ($t = 0$). However, a fur trapper snowed in on the upper MacGregor River might not learn the February 1 price until March 1 ($t = +1$).

NPVs at $t = 0$. Management's updated estimate at $t = 0$ is b , the realization of \tilde{B} .

(4) Negative values for a and b are ruled out. This makes sense for the asset-in-place because of limited liability. It makes sense for the investment opportunity because the opportunity is discarded if it turns out to have a negative NPV at $t = 0$. In other words, the distribution of \tilde{B} is truncated at zero.

(5) Management acts in the interest of the 'old' shareholders, those owning shares at the start of $t = 0$. That is, they maximize $V_0^{\text{old}} = V(a, b, E)$, the 'intrinsic' value of the old shares conditional on the issue-invest decision and knowledge of the realizations a and b . However, the market value of these shares will not generally equal V^{old} , since investors know only the distribution of \tilde{A} and \tilde{B} and whether shares are issued. Let P' be the market value at $t = 0$ of old stockholders' shares if stock is issued, and P the market value at $t = 0$ if stock is not issued.

Old stockholders are assumed passive. They 'sit tight' if stock is issued; thus the issue goes to a different group of investors. If the firm has ample slack, and thus does not need to issue shares in order to invest, old shareholders also sit tight if the investment is made. Thus, acting in old stockholders' interest amounts to maximizing the true or intrinsic value of the *existing shares*. (Here 'true' or 'intrinsic' value means what the shares would sell for, conditional on the firms' issue-invest decision, if investors knew everything that managers know.)

We realize this passive-stockholder assumption may be controversial. We will discuss it further in section 4 below.

(6) Slack, S , is fixed and known by both managers and the market. The information available to management and the market is summarized below:

	$t = -1$ (symmetric information)	$t = 0$ (information advantage to managers)	$t = +1$ (symmetric information)
Information available to:			
Managers	Distributions of \tilde{A} and \tilde{B} ; S	$a, b; S$	a, b ; remaining S , if any
Market	Distributions of \tilde{A} and \tilde{B} ; S	Distributions of \tilde{A} and \tilde{B} ; S ; also E , either $E = 0$ or $E = I - S$	a, b ; remaining S , if any

2.2. Example

The following example should give a better understanding of the problem just posed and the steps required to solve it. Also, the example shows why a firm may pass up a positive-NPV opportunity in a rational expectations equilibrium.

There are two equally probable states of nature. The true state is revealed to management at $t = 0$ and to investors at $t = +1$. Asset values are:

	State 1	State 2
Asset-in-place	$a = 150$	$a = 50$
Investment opportunity (NPV)	$b = 20$	$b = 10$

The firm has no cash or marketable securities ($S = 0$). The investment opportunity requires $I = 100$, so the firm must issue stock to raise $E = 100$ if it goes ahead.

Consider a trial solution in which the firm issues stock and undertakes the project regardless of whether the favorable or unfavorable state occurs. In that case, $P' = 115$ because $\bar{A} + \bar{B} = 115$.

In state 1, the true value of the firm, including 100 raised from the stock issue, is 270. That is $V \equiv V^{\text{old}} + V^{\text{new}} = 270$. The *market* value at $t = 0$ is $P' + E$ (the old shares' market value is P' , the new shares' is E). Thus,

$$V^{\text{old}} = \frac{P'}{P' + E} \cdot V = \frac{115}{215} \cdot 270 = 144.42,$$

$$V^{\text{new}} = \frac{E}{P' + E} \cdot V = \frac{100}{215} \cdot 270 = 125.58.$$

In state 2,

$$V = V^{\text{old}} + V^{\text{new}} = 160,$$

$$V^{\text{old}} = \frac{115}{215} \cdot 160 = 85.58,$$

$$V^{\text{new}} = \frac{100}{215} \cdot 160 = 74.42.$$

Note that both old and new shares are correctly priced to investors, who regard the two states as equally probable.

$$P' = 1/2(144.42 + 85.58) = 115,$$

$$E = 1/2(125.58 + 74.42) = 100.$$

Because the firm issues stock in both states, the decision to issue tells investors nothing about the true state.

But this trial solution is not the equilibrium solution. Look at the payoffs to old stockholders:

Payoff	Issue & invest ($E = 100$)	Do nothing ($E = 0$)
V^{old} in state 1	144.42	150
V^{old} in state 2	85.58	50

With these payoffs, the optimal strategy is to issue and invest only in state 2, because in state 1, the market value of the old stockholders' shares is lower when shares are issued. However, if the firm follows this strategy, issuing stock signals state 2 and P' drops to 60. The equilibrium payoffs are:

Payoff	Issue & invest ($E = 100$)	Do nothing ($E = 0$)
V^{old} in state 1	—	150
V^{old} in state 2	60	—

Thus the firm passes up a good investment project ($\text{NPV} = +20$) in state 1. Its *market* values at $t = 0$ will be $P' = 60$ (state 2) and $P = 150$ (state 1). The *average* payoff to old stockholders is $1/2(150 + 60) = 105$. There is a loss of 10 in ex ante firm value — i.e., at $t = -1$, $V = 105$ vs. a potential value of 115.

In general, whether the firm decides to issue and invest depends on the relative values of a and b in the two states. For example, suppose we had

started with the following table:

	State 1	State 2
Asset-in-place	$a = 150$	$a = 50$
Investment opportunity (NPV)	$b = 100$	$b = 10$

If you work through this case, you will find that the trial solution, in which the firm is assumed to issue and invest in both states, is also the equilibrium solution. The investment opportunity is so valuable in state 1 that the firm cannot afford to pass it up, even though new shares must be sold for less than they are really worth. Since shares are issued in both states, the decision to issue conveys no information, and $P' = \bar{A} + \bar{B} = 155$.

But now let us go back to the original project values, which force the firm not to issue or invest in state 1. In this case we can show that the firm is better off with cash in the bank. If $S = 100$, the payoffs, net of the additional cash investment, are:

Payoff	Invest	Do nothing
V^{old} in state 1	170	150
V^{old} in state 2	60	50

The firm invests in both states⁴ and the ex ante value of the firm's real assets is 115, 10 higher than before, because the firm avoids a 50 percent chance of being forced to pass up investment with an NPV of 20. You could say that putting 100 in the bank at $t = -1$ has an ex ante NPV of 10.

2.3. Discussion

The conventional rationale for holding financial slack – cash, liquid assets, or unused borrowing power – is that the firm doesn't want to have to issue stock on short notice in order to pursue a valuable investment opportunity. Managers point to the red tape, delays and underwriting costs encountered in

⁴These payoffs appear to be create incentive to leave the cash in the bank, and issue stock in state 2. However, that action would immediately reveal the true state, forcing P' down to 60. If the firm does not have to issue stock to undertake the project, smart investors will assume the worst if it does issue, and the firm will find the issue unattractive.

stock issues. They also typically say: 'We don't want to be forced to issue stock when our firm is undervalued by the market.'

A financial economist might respond by asking: 'Managers may have superior information, but why should that be a *disadvantage*? If we admit that the firm is sometimes undervalued, then sometimes it must be overvalued. Why can't firms take advantage of the market by issuing securities only when the firm is overpriced?'

Our examples suggest answers for these questions: slack has value because without it the firm is sometimes unwilling to issue stock and therefore passes up a good investment opportunity. **Slack does not allow the firm to take advantage of investors by issuing only when stock is overvalued:** if investors know the firm does not *have to* issue to invest, then an attempt to issue sends a strong pessimistic signal.

Slack is clearly unnecessary if the firm has a 'private line' to existing stockholders. However, private communication to old stockholders would be difficult and also illegal. Slack is also unnecessary if the firm can compel its old stockholders to buy *and hold* the new issue; in this case, the conflict between old and new stockholders does not exist.

Our examples suggest that slack allows the firm to avoid external financing, and thereby to avoid entangling its investment decisions in possible conflicts of interest between old and new shareholders.⁵ Slack therefore allows the firm to avoid the consequences of managers' inside information. Unfortunately, this conclusion is not as neat as it appears at first, for it rests on assuming that old stockholders are passive, and do not rebalance their portfolios when they learn whether the firm invests. If they do rebalance, conflicts of interest between old and new shareholders occur even if the firm has ample slack. We return to this point in section 4.

2.4. *Information costs*

The value of slack disappears if the firm can costlessly convey its special knowledge to all investors, new as well as old. One way to justify our contrary assumption is to think of cases in which values depend on proprietary information which, if released to the market, would be released to competitors also, consequently reducing either the value of its asset-in-place, the NPV of its investment opportunity, or both.

The firm cannot convey that information by saying: 'We have great prospects, but we can't tell you the details.' In our model, the firm always has the incentive to do this, so such statements carry no information. The firm has to supply *verifiable detail* sufficient to indicate the true state of nature. The costs

⁵Rights issues resolve the conflict of interest only if old stockholders can be compelled to exercise their rights and hold the newly issued shares.

of supplying, absorbing and verifying this information may be significant. Yet making it public will in most cases tell the firm's competitors all they want to know.⁶

There can also be information asymmetries when there is no need to guard proprietary information. Educating investors takes time and money. After all, the managers' information advantage goes beyond having more facts than investors do. Managers also know better what those facts mean for the firm. They have an insider's view of their organization and what it can and cannot do. This organizational knowledge is part of managers' human capital; they acquire it as they work, by conscious effort as well as by trial and error. An outside investor who tried to match an equally intelligent manager on this dimension would probably fail. By this argument, the separation of ownership from professional management naturally creates asymmetric information.

2.5. *Related work*

Our problem is similar to the one addressed by Akerlof (1970), who showed how markets can break down when potential buyers cannot verify the quality of the product they are offered. Faced with the risk of buying a lemon, the buyer will demand a discount, which in turn discourages the potential sellers who do *not* have lemons. However, in our paper, the seller is not offering a single good, but a *partial* claim on two, the asset-in-place and the new project. Moreover, the seller gives up one of them (the new project) if the partial claim is not sold. Without this more complex structure, we would have little to say, beyond noting that securities can be lemons too.

Akerlof's paper was one of the first investigations of the economics of unevenly distributed information. The assumption of asymmetric information underlies extensive recent work on **agency costs**, **signalling**, **adverse selection**, etc. A detailed review of all that is not needed here. However, several articles are directly relevant to our problem:

(1) Campbell (1979) assumes that firms have proprietary information that would be costly to convey to the market. He describes the resulting financing difficulties and possible remedies. His main point is to provide a new rationale

⁶What is it that competitors want to know? There are two possibilities:

- (a) They want to know the *value* of the firm's assets and opportunities – in our example, the true state, $s = 1$ or 2 . (In the example, the firm cannot help revealing the true state if it has to issue to invest.)
- (b) They want to know technology, product design, management strategy, etc. – that is, *how* the value is generated. In this case, knowing the true state would not help competitors at all. We assume that the investment opportunity's NPV is independent of whether stock has to be issued to finance it. Thus we are implicitly assuming (b), not (a). But if (a) is important, then slack may have still another payoff: If the firm does not have to issue to invest, it can more easily conceal the true value of its assets and growth opportunities. Its *ex ante* investment opportunity set, described by the distribution of \tilde{B} , may be more favorable with slack than without it.

Issuing stock can fully reveal the true state s only in simple two-state examples. But these comments also apply – if suitably watered down – to the more general cases in section 3.

for debt financing through financial intermediaries. It may, for example, be possible to reveal proprietary information to a bank without revealing it to competitors; the bank could then finance a new project on terms which are fair to old stockholders. This line of analysis is further explored in Campbell and Kracaw (1980).

However, Carapbell does not consider what happens if a firm with proprietary information does attempt a public issue. He presents no formal equilibrium model of security pricing and of the financing and investment decisions of the firm.

(2) Leland and Pyle (1977) consider an entrepreneur seeking additional equity financing for a single venture. The entrepreneur knows the project's expected return but outside investors do not. However, the outside investors observe the fraction of the entrepreneur's personal wealth committed to the project, and set their valuation accordingly. The greater the entrepreneur's willingness to take a personal stake in the project, the more investors are willing to pay for their share of it.⁷

This suggests a possible extension to our model. If managers *also* are (old) stockholders, then managers' inside information may be conveyed by the amount of the new issue they are willing to buy for their personal portfolios.

(3) Bhattacharya and Ritter (1983) pose a problem similar to ours, but end up pursuing a different issue. We fix the extent of managers' inside information and examine the equilibrium issue-invest decision. They ask how much information the firm *should* reveal, assuming that each revelation provides information to competitors as well as investors, and therefore reduces the value of the firm. They show that the firm may be able to convey its true value to investors without revealing everything its competitors would like to know. However, their search for signalling equilibria carries them a long way from this paper's analysis.

(4) Rendleman (1980) also sets a problem similar to ours. His investors may over- or undervalue the firm's assets or investment opportunities or misassess its risk. He focuses on the choice between debt and equity financing, but does not derive a full equilibrium model. For example, he shows that undervalued firms will typically prefer debt, but does not model the market's response to the firm's choice of debt over equity. In general management's choice of financing must convey information about the firm's intrinsic value and actual risk. In our model however, the firm *never* issues equity when it has the option to issue debt, regardless of whether the firm is over- or undervalued. We prove this later in the paper.

(5) Giammarino and Neave (1982) present a model in which the firm and investors have different perceptions of the risk – e.g., variance – of the return

⁷Downs and Heinkel (1982) present empirical evidence supporting the Leland-Pyle analysis.

on an investment opportunity, but agree on the mean return. They concentrate on the choice among financing instruments, and develop a rationale for convertibles. Our model is in most respects more general, since we allow different information about any aspect of the distributions of asset values. However, we do not consider convertibles as such. We have further comments on these authors' results in section 4.

(6) Miller and Rock (1982) present a model of dividend policy under asymmetric information. If the amount of investment and external financing is held fixed, the cash dividend paid by the firm reveals its operating cash flow. Thus, a larger-than-expected dividend reveals larger-than-expected cash flow, and stock price increases. A larger-than-expected external financing reveals lower-than-expected cash flow, which is bad news for investors. Thus Miller and Rock's model predicts that announcements of new security issues will, on average, depress stock price. So does our model, as we will show in section 3. However, ours also yields more specific hypotheses about what kinds of securities firms choose to issue and how that choice affects the magnitude of the stock price change. These issues, and the relevant empirical evidence, are discussed further in section 4.

(7) There are other theoretical papers exploring how managers' inside information is signalled to investors. They include Bhattacharya's work on dividend policy (1979), Grossman and Hart's (1981) work on takeover bids, and Ross's (1977, 1978) papers on 'financial incentive signalling', in which a manager's employment contract leads him to convey information about the firm's prospects through a choice of its capital structure. There are also tempting analogies between our paper and the literature on credit rationing. See, for example, Jaffee and Russell (1976) and Stiglitz and Weiss (1981).

3. The formal model

In this section, we give a formal statement and solution of the model introduced in section 2. We assume $0 \leq S < I$ so that some or all of the project must be financed by a stock issue. By varying slack S , we vary the size of the required issue, $E = I - S$.

If the firm, knowing the true values a and b , does not issue, it forfeits the investment opportunity, so $V^{\text{old}} = S + a$. The slack remains in cash or liquid assets. If it does issue and invest, $E = I - S$ and

$$V^{\text{old}} = \frac{P'}{P' + E} (E + S + a + b).$$

Old stockholders are better off (or will be at $t = +1$) if the firm issues only

when

$$S + a \leq \frac{P'}{P' + E} (E + S + a + b),$$

or when

$$\frac{E}{P' + E} (S + a) \leq \frac{P'}{P' + E} (E + b),$$

[(share of existing assets and slack going to new stockholders) \leq (share of increment to firm value obtained by old stockholders)]. The condition can also be written

$$(E/P')(S + a) \leq E + b. \quad (1)$$

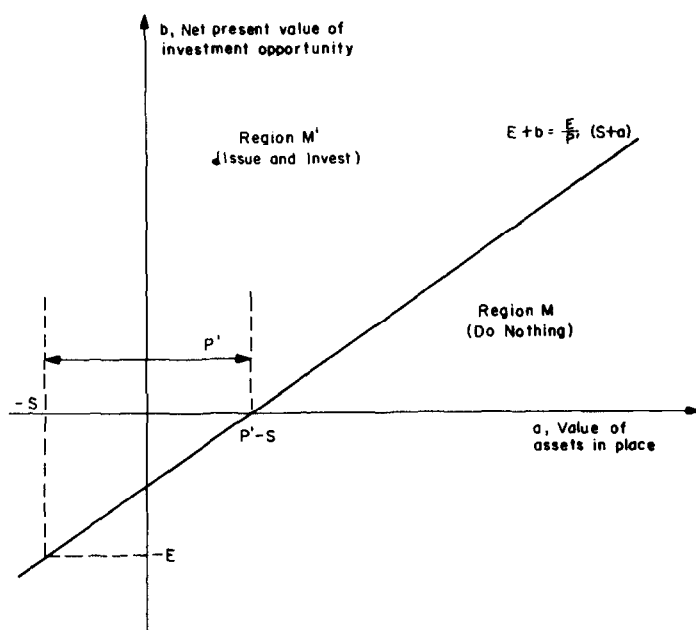


Fig. 1. The issue-invest decision when managers know more than investors about the value of the firm's assets-in-place (a) and the net present value of its investment opportunities (b). The firm issues stock only if (a, b) falls in region M' . E is the amount of new equity required to finance the investment, P' the equilibrium value of the firm conditional on issue, and S is the amount of financial slack (financing available from internal sources).

Thus the line

$$(E/P')(S + a) = E + b \tag{1'}$$

divides the joint probability distribution of \tilde{A} and \tilde{B} into two regions, as shown in fig. 1. If the actual outcome (a, b) falls in region M' , the firm issues and invests. If the outcome falls in region M , the firm does nothing: it is willing to give up the NPV of its investment opportunity rather than sell shares for less than the shares are really worth. (Fig. 2 displays the numerical example presented above in the format of fig. 1.)

Remember that the joint probability distribution of a and b is restricted to the Northeast quadrant of fig. 1. Region M' is at the top left of this quadrant. The firm is most likely to issue when b , the realization of project NPV, is high and a , the realization of value of the asset-in-place, is low. The higher b is, the more old stockholders gain from issuing and investing. The lower a is, the more attractive the issue price P' .

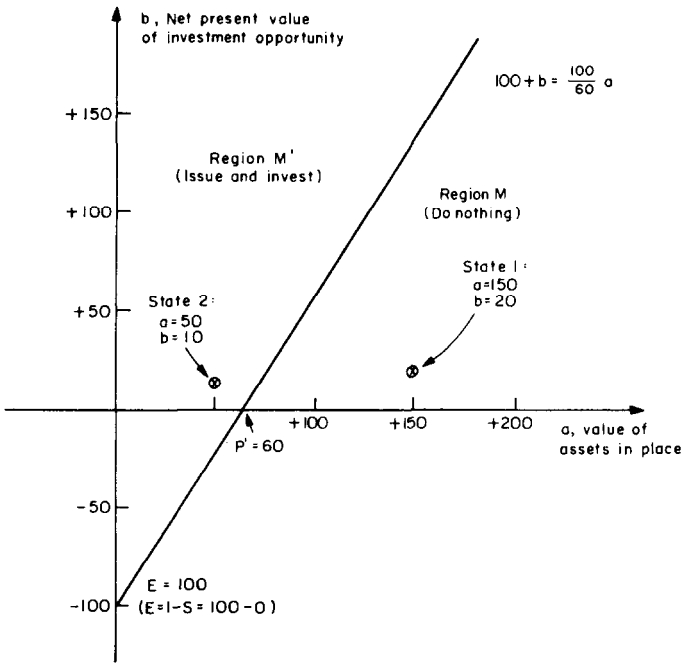


Fig. 2. Solution for example from section 2. In this case, the firm issues and invests in state 2, when assets-in-place are worth 50 and the net present value of the investment opportunity is 10 – i.e., where $(a, b) = (50, 10)$. It does not issue or invest in state 1, where $(a, b) = (150, 20)$. The states are assumed equally probable. Firm value conditional on issue is $P' = 60$.

Of course P' itself depends on the probability densities of (\tilde{A}, \tilde{B}) in the regions M and M' , and the boundaries of M and M' depend on P' . Thus P' , M and M' are simultaneously determined. The stock issue will be fairly priced to investors if

$$P' = S + \bar{A}(M') + \bar{B}(M'), \quad (2)$$

where $\bar{A}(M') \equiv E(\tilde{A}|E = I - S)$ and $\bar{B}(M') \equiv E(\tilde{B}|E = I - S)$. These expectations reflect only the information available to investors: the distribution of \tilde{A} and \tilde{B} and the decision to issue, which tells investors that the true values a and b satisfy eq. (1).

3.1. Properties of equilibrium

These equilibrium conditions imply that the firm may pass up good opportunities rather than selling stock to raise funds. This occurs with probability $F(M)$. The ex ante loss in value is $L \equiv F(M)\bar{B}(M)$. There is no loss when the firm has sufficient slack to finance the investment – that is, $L = 0$ when $S \geq I$. If on the other hand, $S < I$, as we will assume in the following discussion, the ex ante loss increases as E , the size of the required equity issue, increases. Since $E = I - S$, the loss also increases with the required investment I and decreases with slack available S .⁸

3.1.1. Special cases

'Corner solutions', in which the firm always issues stock or never issues stock, are rarely encountered in this model given reasonable joint probability distributions for \tilde{A} and \tilde{B} . This occurs because both \tilde{A} and \tilde{B} are random and have positive means, and because the investment decision cannot be postponed. The following special cases do give corner solutions, however. First, if a is known by investors as well as managers, then stock is always issued when $b \geq 0$, and thus $L = 0$. To show this, first substitute a for $\bar{A}(M')$ in eq. (2),

$$P' = S + a + \bar{B}(M').$$

Since $\bar{B}(M') \geq 0$, $P' \geq S + a$. The firm will issue stock if

$$E\left(\frac{S + a}{P'}\right) \leq E + b.$$

⁸A formal proof is given in Majluf (1978, pp. 286–290, see also pp. 142–143).

This condition must be satisfied, because $(S + a)/P' \leq 1$ and $b \geq 0$. The firm will issue whenever the investment opportunity has zero or positive NPV ($b \geq 0$). The market value of the old stockholders' stake in the firm, conditional on issue, is therefore $P' = S + a + \bar{B}$.

In our model, asymmetric information restricted to investment opportunities never prevents a stock issue. The terms of sale may be favorable to the firm (if $b < \bar{B}$) or unfavorable (if $b > \bar{B}$), but even in the latter case the firm is better off issuing than losing the project entirely.

This suggests that some firms would be better off splitting assets in place away from growth opportunities. For example, if the asset-in-place can be sold for a , without affecting b , then the problems addressed in this paper evaporate.⁹ If the investment opportunity has zero or positive NPV ($b \geq 0$), then the firm sells the asset-in-place. If the proceeds cover the investment required ($a \geq I$), it goes ahead. However, it also goes ahead if $a < I$, because selling the asset-in-place reveals its true value. As we have just shown, asymmetric information restricted to investment opportunities never prevents a stock issue.¹⁰

On the other hand, the firm might simply spin off its asset-in-place as a separately-financed company. In our model, stockholders are better off *ex ante* holding two firms rather than one, providing that the spinoff does not reduce the values of the distributions \tilde{A} and/or \tilde{B} .

Now consider the case in which the firm has no investment opportunities ($\tilde{B} = 0$ in all states of the world). Here things break down totally:¹¹ stock is never issued, except possibly when a is at a definite lower bound. Let a_{\min} denote the lower bound: assume that both investors and the firm know that a cannot be less than a_{\min} . (Note we have reintroduced asymmetric information about a .) Then P' cannot be less than $a_{\min} + S$, because everyone would then know the firm's shares were underpriced. But $P' > a_{\min} + S$ can also be ruled out, for it leads to a contradiction. To see why, substitute $P' = a_{\min} + S + e$ in eq. (1). With $e > 0$, the firm issues only if $a \leq a_{\min} + e$. Therefore, $\bar{A}(M') < a_{\min} + e$ and $P' > S + \bar{A}(M')$, which violates eq. (2).

So the only possibility for P' when $b = 0$ is $P' = a_{\min} + S$. In that case, the firm only issues when $a = a_{\min}$. It never issues when $a > a_{\min}$, because then

$$E\left(\frac{S + a}{P'}\right) > E,$$

which violates eq. (1).

⁹What if only part of the asset-in-place can be sold? If it can be sold at intrinsic value, the firm treats the proceeds as additional slack and looks again at its issue-invest decision.

¹⁰What if the asset-in-place can only be sold at a discount? What if the potential buyer does not know its true value? What if sale of the asset-in-place reduces b ? These questions are worth exploring.

¹¹This is the case of market breakdown analyzed by Akerlof (1970).

If b is positive and investors know its value, the firm will issue and invest in at least some states where $a > a_{\min}$. It may issue in *all* states – that is, if b is large enough, it may issue even if a is far out on the right-hand tail of its distribution.

One insight of this model is that you need asymmetric information about *both* assets in place and investment opportunities to get interesting solutions. For example, without asymmetric information about assets-in-place, stock is always issued when the firm has a positive-NPV opportunity; asymmetric information does not affect real investment decisions.

3.1.2. *The impact of stock issues on stock price*

In our model, **the decision to issue stock always reduces stock price, unless the issue is a foregone conclusion**. That is equivalent to saying that $P' < P$ if the probability of issue is less than 1.0. (Note that this rules out the ‘corner solution’ in which investors know what managers know about the value of assets in place.) **If the firm is sure to issue, then the issue conveys no information, and $P' = P$.**

The proof is simple. Note that $P = \bar{A}(M) + S$, the expected value of assets in place and slack conditional on *not* issuing, or in other words, conditional on the realizations a and b falling in region M in fig. 1. Assume M is not empty – there is some probability of no issue. Then a glance at fig. 1 shows that all realizations of a which fall in M exceed $P' - S$, and $\bar{A}(M)$ must exceed $P' - S$. Since $P - S = \bar{A}(M)$, $P - S > P' - S$ and $P > P'$.

Or look at it this way: the *reason* a firm decides *not* to issue is that $a > P'(1 + b/E) - S$. [This follows from reversing and rearranging eq. (1).] Since $b/E \geq 0$, the decision not to issue signals $a > P' - S$ or $a + S > P'$. In other words, it signals that the true values of slack and assets in place exceed P' , the price of the ‘old’ shares if new shares are issued. Since $P = \bar{A}(M) + S$, P must exceed P' , and price must fall when the issue–invest decision is revealed.

Note that both P and P' incorporate all information available to investors. They are rationally-formed, unbiased estimates of the firm’s intrinsic value. They reflect knowledge of the firm’s decision *rule* as well as its decision. P exceeds P' because investors rationally interpret the decision not to issue as good news about the true value of the firm.¹²

¹²Issue costs do not appear to change the structure of our model in any fundamental way. However, we comment on them here because including them may qualify our proof that stock price falls when the firm issues shares.

Suppose the firm incurs issue costs of T dollars. This increases the amount it has to issue to finance the project from E to $E + T$. That is, it must issue a gross amount $E + T$ in order to net E .

3.1.3. Comment

Why should stock issues always convey bad news? Might not investors view some issues as confirming the existence of a positive-NPV opportunity? That ought to be good news, not bad.

We will now explain why our model rules out this optimistic response. To do so requires a bit of backtracking, however.

We have assumed that \bar{B} , the NPV of the firm's investment opportunity at $t = 0$, is non-negative. Negative-NPV investments ($\bar{B} < 0$) would never be undertaken. Even if the firm encountered a negative-NPV investment and raised sufficient money to undertake it, it would never go ahead. It would put the money in the bank instead, or into some other zero-NPV investment. (It can buy other firms' shares, for example.) Thus, the distribution of \bar{B} is truncated at $\bar{B} = 0$.

There may, however, be a high probability that the realization b will be exactly zero. What does the firm do when this happens (when $b = 0$)? Answer: it follows the rule stated above, issuing if

$$(E/P')(S + a) \leq E + b,$$

[eq. (1)] or, with $b = 0$, if $P' \geq S + a$ or $a \leq P' - S$. In fig. 1, the points (a, b) for which $b = 0$ and $a < P' - S$ lie on the horizontal axis to the left of the line separating regions M and M' . In other words, M' includes (its share of) the horizontal axis.

The higher issue costs are, the smaller the fraction of the post-issue shares held by old stockholders. The firm issues and invests if:

$$V_{\text{issue}}^{\text{old}} = \frac{P'}{P' + E + T}(E + S + a + b) \geq S + a = V_{\text{no issue}}^{\text{old}},$$

or if

$$\frac{E + T}{P'}(S + a) \leq E + b.$$

The market value P' of the old stockholders' shares conditional on issue is $\bar{A}(M')\bar{B}(M') + S - T$. The region M' is now defined by the inequality given just above.

Issue costs appear to lead to two main differences in the equilibrium properties of the model. First, the firm may issue and invest when its investment opportunity's NPV is positive, but less than T ($0 \leq b < T$). This creates a different sort of real resource cost. In this region, the project actually has *negative* NPV once issue costs are allocated to it ($b - T < 0$). Nevertheless, the investment may be rational if managers know the value of assets-in-place is sufficiently low. If this outcome is possible, the ex ante market value of the firm will be marked down accordingly.

Second, we can no longer say for sure that $P' < P$, and that the decision to issue shares drives down the price. The proof given in the text follows from the observation that $\bar{A}(M) > P' + S$. With issue costs, the corresponding statement is $\bar{A}(M) > P'(E/(E + T)) - S$. It is conceivable that $\bar{A}(M)$ would fall between $P'(E/(E + T)) - S$ and $P' - S$. The conditions under which this might happen are worth investigating further. For present purposes, however, we have to assume that transaction costs are a second-order effect.

Since the firm issues whenever (a, b) falls in region M' , even when it has only zero-NPV opportunities, the decision to issue does not signal 'positive-NPV investment' but only 'region M' .' We have already shown that the rational investor reaction to region M' is 'bad news'.

This does not imply that the firm will always issue when it has no positive-NPV opportunity ($b = 0$). It issues only when the value of its assets-in-place is low enough to make the issue attractive – i.e., when $a \leq P' - S$. Moreover, the higher the probability that $b = 0$, other things equal,¹³ the lower P' , and the lower the probability of issue. In the limit, when $b > 0$ is ruled out entirely, the firm will never issue, except possibly when the realization of a falls at a definite lower bound. (This is one of the corner solutions discussed above.)

The intuition that stock issues confirm the existence of positive-NPV projects must therefore be rejected if our model is right. That intuition might be borne out if managers could commit to refrain from issuing when $b = 0$, but this is not a credible policy if managers act in the old shareholders' interests.

3.2. Numerical solutions

The analysis presented so far establishes that the firm may rationally forego a valuable investment opportunity if common stock must be issued to finance it. We would also like to have some indication of the probability of this event and the magnitude of the ex ante loss in firm value. For that we have to turn to numerical methods.

The key to a numerical solution is of course P' : once we know it, we can use eq. (1') to separate regions M' and M . Unfortunately, we cannot guarantee a unique P' – it depends on the joint probability distribution of a and b .¹⁴ Nor can we give a more specific analytical expression for P' , although calculating P' by numerical methods is not difficult. The method we have used is:

- (1) Start by setting $P' = S + \bar{A} + \bar{B}$. This assumes the firm always issues stock if $b > 0$.
- (2) Then determine the regions M and M' , assuming the firm faces this trial value for P' and acts in the old stockholders' interest.
- (3) Calculate a new trial value of $P' = S + \bar{A}(M') + \bar{B}(M')$ based on the regions M and M' from step 2.
- (4) Continue until P' converges.

This procedure gives the highest equilibrium P' . In our numerical experiments this value has always been a unique solution for joint lognormal distributions

¹³Other things' includes the expectation of \bar{B} given that it is positive.

¹⁴Majluf (1978, pp. 279–285) shows that at least one equilibrium P' exists if there is a positive probability that the firm will issue stock.

Table 1

Expected ex ante losses in firm value when the value of assets-in-place (\tilde{A}) and the net present value of investment opportunities (\tilde{B}) are lognormally distributed. \tilde{A} and \tilde{B} are assumed independently distributed, with expectations $\bar{A} = 100$ and $\bar{B} = 1$ or 10, and standard deviations $\sigma_A = 10$ or 100 and $\sigma_B = 10$. The probability distributions reflect information available to investors before the firm reveals whether it will issue and invest. The investment required is $I = 10$ or 100. Financial slack, S , is varied between 0 and 100 percent of I . The losses are expressed as a percent of \bar{B} . The probability that the firm will issue is given in parentheses.^a

S	\bar{B}/I	$I = 10$		$I = 100$	
		$\sigma_A = 10$	$\sigma_A = 100$	$\sigma_A = 10$	$\sigma_A = 100$
0	0.01	99.8 (0.1)	100 – (0 +)	98.5 (1.2)	99.9 (0.1)
	0.10	17.8 (68.4)	97.8 (1.6)	2.8 (94.1)	68.8 (28.0)
50	0.01	94.1 (3.2)	100 – (0 +)	68.7 (21.7)	97.1 (2.1)
	0.10	5.1 (87.0)	84.4 (11.2)	0.4 (98.6)	39.4 (51.7)
90	0.01	19.9 (65.2)	97.0 (1.9)	5.7 (85.8)	65.0 (25.9)
	0.10	0.1 (99.5)	18.7 (70.5)	0 + (100 –)	5.1 (89.6)
100	0.01	0 (0)	0 (0)	0 (0)	0 (0)
	0.10	0 (0)	0 (0)	0 (0)	0 (0)

^aSource: Majluf (1978, tables 4 and 6).

of \bar{A} and \bar{B} , and also for joint normal distributions truncated to exclude negative \tilde{A} 's and \tilde{B} 's.

Table 1 illustrates the results obtained in extensive numerical experiments.¹⁵ It shows L , loss in market value at $t = -1$, as a percent of \bar{B} , the average NPV of the investment opportunity. It also shows $F(M')$, the probability the firm will issue stock and invest. \tilde{A} and \tilde{B} are assumed joint lognormally distributed and slack is varied from zero to the required investment I . Note that:

- Increasing slack reduces L/\bar{B} and increases $F(M')$.
- Increasing project NPV (\bar{B}/I) reduces L/\bar{B} .
- Reducing the standard deviation of assets in place σ_A reduces the loss in value. (We showed above that $L = 0$ when $\sigma_A = 0$.)

We also experimented with the standard deviation of B and the correlation of \tilde{A} and \tilde{B} , but found no uniform effects.

¹⁵Reported in Majluf (1978, pp. 165–183).

3.3. Debt financing

So far, we have assumed that the firm can raise external funds only by issuing stock. Now we will adapt the model to include the choice between debt and equity issues.

If the firm can issue default-risk-free debt, our problem disappears: the firm never passes up a positive-NPV investment. If it can only issue risky debt, our problem is only alleviated: the firm sometimes passes up positive-NPV investments, but the average opportunity loss is less with debt than with equity financing. The general rule seems to be: better to issue safe securities than risky ones.

This requires more careful discussion. Assume the money needed for the investment opportunity ($I - S$) can be financed by debt, D , or equity, E . Assume for the moment that these are two distinct policies announced at $t = -1$ and adhered to in $t = 0$. That is, the firm must choose debt or equity before managers know the true values a and b .

The firm issues and invests if V^{old} , the intrinsic value of the old stockholders' equity, is higher with the issue than without it. If it does issue, V^{old} equals total firm value less the value of the newly issued securities.

Suppose equity is issued. Then $V^{\text{old}} = a + b + I - E_1$, where E_1 is the newly issued shares' market value at $t = +1$, when investors learn a and b . The issue price of these shares is just $E = I - S$ at $t = 0$. Thus $V^{\text{old}} = S + a + b - (E_1 - E) = S + a + b - \Delta E$; ΔE is the new shareholders' capital gain or loss when the truth comes out at $t = +1$, conditional on the firm's issue of shares at $t = 0$.

The firm will issue and invest only if

$$S + a \leq S + a + b - \Delta E, \quad (3)$$

or if $b \geq \Delta E$. The investment's NPV must equal or exceed the capital gain on newly issued shares. (Note: ΔE may be positive or negative. At equilibrium investors *expect* it to be zero. The firm knows the true value.)

If debt is issued, we follow exactly the same argument, with D and D_1 substituted for E and E_1 , and reach the same conclusion: the firm will issue and invest only if b equals or exceeds $\Delta D \equiv D_1 - D$. Of course if the debt is default-risk-free, $\Delta D = 0$,¹⁶ and the firm always issues and invests when $b \geq 0$. Thus, the ability to issue risk-free debt is as good as financial slack. If the debt is not default-risk-free, ΔD may be positive or negative. Option pricing theory

¹⁶That is, the change in the debt value at $t = 1$ is independent of the firm-specific information revealed to investors at that time. Other things, such as a general shift in interest rates, may change debt value, but that is irrelevant here.

tells us that ΔD will have the same sign as ΔE , but that its absolute value will always be less.¹⁷ We so assume for the moment.

Now compare the issue-invest decisions for debt vs. equity financing. Since $b \geq 0$, the firm will always invest when ΔD and ΔE are zero or negative. Suppose ΔD and ΔE are positive (good news in store for investors at $t = +1$). If the firm is willing to issue equity and invest, it is also willing to issue debt ($\Delta D < \Delta E$, so $b \geq \Delta E$ implies $b > \Delta D$). However, debt is issued in some states where equity is not ($\Delta D \leq b < \Delta E$). Thus, the ex ante value of the firm is higher under the debt-financing policy, because the loss in market value (L) due to underinvestment is less.

Now suppose the choice of debt or equity is not preannounced, but chosen at $t = 0$, after the firm knows the values a and b . This seems a more complicated problem, for the choice could give an additional signal to investors. It's tempting to say the overvalued firm would issue equity and the undervalued firm debt.¹⁸

In our model, however, *the firm never issues equity. If it issues and invests, it always issues debt*, regardless of whether the firm is over- or undervalued. A proof follows.

The payoff to old stockholders (V^{old}) if neither debt or equity is issued is $a + S$. The additional payoffs to issuing and investing are $b - \Delta E$ with equity financing and $b - \Delta D$ with debt financing. An equity issue therefore signals that $b - \Delta E > b - \Delta D$, that is $\Delta E < \Delta D$.

Remember that ΔE and ΔD are the gains realized by new stock or bondholders at $t = +1$ when the firm's true value is revealed. They depend on a , b , S and the decision to issue and invest. If there is an equilibrium in which equity is issued, there is a price P'_E at which investors can rationally expect $\Delta E = 0$. For debt, the equilibrium firm value is P'_D and investors expect $\Delta D = 0$. Given a , b and S , ΔE and ΔD have the same sign, but $|\Delta E| > |\Delta D|$.

However, there is no equilibrium price P'_E at which the firm can issue stock. It prefers stock to debt only if P'_E is high enough that $\Delta E < \Delta D$. This occurs only if $\Delta E < 0$, implying a sure capital loss for new stockholders. Therefore, there can be no price P'_E at which (1) the firm is willing to issue stock rather than debt and (2) investors are willing to buy.

To put it another way: suppose the firm announced at $t = -1$ that it would issue debt if it issued any security. It could not change its mind and issue equity at $t = 0$, because investors would assume this meant $\Delta E < 0$ and refuse

¹⁷See, for example, Galai and Masulis (1976). The option pricing framework of course rests on more restrictive assumptions than those used so far in this paper. We return to these assumptions below.

¹⁸This is Rendleman's conclusion (1980). As noted above, he does not work out a full equilibrium solution.

to buy. On the other hand, a firm which announced a policy of equity financing at $t = -1$ would be forced to change its mind, and to issue debt at $t = 0$ if it issued at all. Equity would be issued at $t = 0$ only if debt were ruled out at $t = -1$; yet we showed above that precommitting to equity financing is always inferior to precommitting to debt.

Thus, our model may explain why many firms seem to prefer internal financing to financing by security issues and, when they do issue, why they seem to prefer bonds to stock. This has been interpreted as managerial capitalism – an attempt by managers to avoid the discipline of capital markets and to cut the ties that bind managers' to stockholders' interests. In our model, this behavior *is* in the stockholders' interest.

3.4. Equity issues in asymmetric information models

The chief difficulty with this analysis of the debt–equity choice is that we end up leaving no room at all for stock issues. We could of course recreate a role for them by introducing agency or bankruptcy costs of debt, as discussed in, for example, Jensen and Meckling (1976), Myers (1977), and Smith and Warner (1979). But it is also possible to rationalize equity issues in models based on information asymmetries alone.

Our proof that **debt dominates equity uses the standard option-pricing assumption that percentage changes in value are lognormally distributed with a constant variance rate known by everyone**. However, suppose there is a large information asymmetry about the (future) variance rate. If investors underestimate the variance rate, the firm will be tempted to issue debt, but if they overestimate it, the firm will be tempted to issue equity, other things equal. Thus, a decision to issue equity may not signal a sure capital loss for new stockholders, but simply that the firm is safer than prospective bondholders think. Thus equity issues are not completely ruled out in equilibrium.

Giammarino and Neave (1982) set up a model in which the managers and investors share the same information about *everything except risk*. In this case, equity issues dominate debt issues, because the only time managers want to issue debt is when they know the firm is riskier than investors think. Investors, realizing this, refuse to buy. Only equity, or perhaps a convertible security, is issued in equilibrium.

Firms actually seem to favor debt over equity issues, not the reverse. We believe asymmetric information about firm value is a stronger determinant of financing behavior than asymmetric information about risk, and we will so assume in subsequent comments, although future empirical research could of course prove us wrong. On the theoretical side, an obvious next step is to analyze the debt–equity choice in a version of our model which explicitly

allows information asymmetry on the two dimensions of firm value and firm variance.¹⁹

4. Assumptions about management's objectives

We have shown that ample financial slack allows the firm to avoid external financing and to disentangle investment decisions from conflicts of interest between old stockholders and new investors. However, this result depends on management's acting in the interest of *passive* stockholders. We will now consider how rational stockholders react to the firm's investment decision. We show that, in frictionless capital markets, their reaction does not depend on whether the investment is financed with internal or external funds.²⁰

4.1. The irrelevance of financing

Take the simplest case, in which the firm can only issue stock. When the firm has inadequate slack ($S < I$), we showed that the firm may pass up valuable investment opportunities. This loss would be avoided if old stockholders could be compelled to buy *and hold* the new issue – in other words, to accept the new asset in their own portfolios. In general, this will not be their optimal portfolio strategy, however, so new shareholders enter, creating the conflict.

Now suppose the firm has ample slack ($S = I$). Old stockholders arrive at $t = 0$ with shares representing a portfolio of three items: an asset in place, a growth opportunity and cash. If the growth opportunity is taken, the cash vanishes, and the portfolio changes to two assets in place. The old stockholders 'buy' all of the new asset via the firm's internal financing. However, there is nothing to force them to hold it. The same portfolio motives that would prevent them from buying all of a new issue should prompt them to sell part of their shares if the firm uses its cash to buy a risky real asset.

There is no deadweight loss so long as the firm buys this asset whenever it has positive NPV ($b > 0$). However, suppose managers start to worry about the price old shareholders trade at when they rebalance their portfolios after an internally-financed investment is made. Table 2 sets out equilibrium conditions for this case. The left-hand block (case I) shows old shareholders' payoffs if the firm has no slack. We assume old shareholders *could* buy all of the new issue. Therefore, we earmark $C = I$ dollars of cash and other securities and take it as potentially available for investment. However, their optimal portfolio calls for

¹⁹Note that the general version of our model, as described in eqs. (1) and (2), allows asymmetric information about any feature of the joint distribution (\bar{A} , \bar{B}). But addressing the choice among financing instruments requires more specific assumptions.

²⁰We thank George Constantinides for suggesting this possibility.

investing αI in the new issue. The resulting equilibrium conditions are slight generalizations of those given in section 3 above (we previously took $\alpha = 0$).

In the right-hand block (case II), the firm holds the same amount of cash *on behalf of* old shareholders. If the firm invests this cash, they recoup part of it by selling shares to raise $(1 - \alpha)I$. Their fractional ownership thus ends up as $(P'' - (1 - \alpha)I)/P''$. Note that P'' , the market price of the firm conditional on investment, includes the investment I . It's convenient to substitute $P''_{\text{net}} \equiv P'' - I$.

At equilibrium, $P''_{\text{net}} = \bar{A}(M'') + \bar{B}(M'')$, where M'' indicates the states in which investment by the firm is in the old shareholders' interest given the price P''_{net} facing them when they sell.

The equilibrium conditions for the two cases shown in table 2 are identical. The firm's investment decision is independent of whether cash starts out in the shareholders' bank accounts or the firm's. The firm passes up good investment opportunities in the same states, so the ex ante loss L is the same for the two cases.²¹ So are the market prices conditional on the decision to invest: $P' = P''_{\text{net}}$.

The choice between debt and equity financing should not matter either. Suppose the starting position is case I in table 2. The firm borrows $C = I$ dollars from its stockholders. That transforms case I into II, if the debt is default-risk-free. The final equilibrium investment decision and stock price are unaffected.

If the debt carries default risk, old shareholders are exposed to the firm's business risk through their new debt securities as well as their stock. Therefore, when the firm invests, they will raise $(1 - \alpha)I$ by selling a mixture of debt and equity securities – the same fraction of their holdings of each. However, the same final equilibrium is reached again.

If the risky debt is sold to outsiders, old shareholders would buy part of the debt issue, and sell some of their shares. However, as long as capital markets

²¹If old shareholders are willing to hold all of any new investment – i.e., if $\alpha = 1$ in table 2's expressions – the firm always invests if $b > 0$. This is, of course, the ex ante optimal policy; the problem is enforcing it. Old shareholders could enforce it by purchasing 100 percent of any new issue (case I) or by not selling any of their shares (case II).

However, note that the incentive for old shareholders to buy all of a new issue is strongest if they act in concert. Management looks at the overall α . An investor who holds, say, one percent of the firm's stock, and who acts alone, buying one percent of the new issue, will reap only one percent of his action's rewards. If arranging a group action is costly, then individual investors' incentives will not make $\alpha = 1$ overall.

In case II, $\alpha = 1$ if old shareholders do *not* trade when the firm invests. Financial slack helps by making sure that old shareholders buy all of the new project, at least temporarily. Trading costs then limit the extent of selling. If their portfolios are 'sticky', the conflict of interest between old and new shareholders is reduced. However, any investor who sells out will not face the full cost of his actions, since management's decision depends on old stockholders' overall participation in the new project.

Table 2

Equilibrium conditions for the issue-invest decision with and without financial slack.

	(I) Firm has no slack ($S = 0$), and must issue the amount I in order to invest. Share- holders have cash $C = I$ and invest αI in new issue. Managers know a , the value of assets-in-place, and b , the net present value of the in- vestment opportunity, but in- vestors do not.	(II) Firm has $S = I$. However, if it invests, shareholders sell a portion of their holdings to recover $(1 - \alpha)I$ in cash. Managers and investors have the same information as in case I.
Value to old shareholders (V^{old})		
No issue:	$C + a = I + a$	$S + a = I + a$
Issue:	$(1 - \alpha)I + \frac{P' + \alpha I}{P' + I}(I + a + b)$	$(1 - \alpha)I + \frac{P'' - (1 - \alpha)I}{P''}(I + a + b)$ or $(1 - \alpha)I + \frac{P''_{\text{net}} + \alpha I}{P''_{\text{net}} + I}(I + a + b)$
Issue if:	$I + a < (1 - \alpha)I + \frac{P' + \alpha I}{P' + I}(I + a + b)$	$I + a < (1 - \alpha)I + \frac{P''_{\text{net}} + \alpha I}{P''_{\text{net}} + I}(I + a + b)$
At equilibrium: ^a	$P' = \bar{A}(M') + \bar{B}(M')$	$P''_{\text{net}} = \bar{A}(M'') + \bar{B}(M'')$

^aThe equilibrium values of the firm (P' in case I and P''_{net} in case II) are identical. Thus, the investment decision can be independent of whether financing comes from internal funds or a stock issue. Here we assume that investors rebalance their portfolios when the firm reveals its investment decision.

are frictionless, and all traders understand what is going on, the final result is the same.

We thus obtain an (MM) proposition of financial irrelevance, where all the action comes from the firm's decision to invest. If this tack is taken, our model's empirical implications change. We could not explain firms' demands for slack, their apparent preference for internal financing, or for debt over equity issues. A fall in stock price on announcement of a stock issue would be explained as an information effect. That is, the issue would not matter in itself, but only as a signal of the decision to invest.

However, before we turn to the empirical evidence, we will devote a few more words to the competing descriptions of management objectives and shareholder responses when managers know more than shareholders do.

4.2. *Ex ante optimal policies*

Old shareholders are better off *ex ante*, and on average *ex post*, if management takes all positive-NPV projects. Perhaps compensation packages have

features that prompt managers to follow this rule. Social conventions or corporate cultures that encourage managers to maximize 'long-run value' may have the same effect. Also, following the rule may be in managers' self-interest: a manager who does *not* allow conflicts between old and new shareholders' interests to block positive-NPV projects could demand a higher salary *ex ante* than one who does.

However, management must take *some* responsibility for financing. Consider the extreme instruction: 'Take all positive-NPV projects and issue securities at *any* price.'

The 'wrong' price for a security issue does not affect firm value. It just transfers value from some securityholders to others. Nevertheless, the instruction is not credible. Public stockholders would not support it, because it would leave them unprotected against sweet deals given to insiders or their friends.²²

Of course this sort of sweet deal is illegal. An outside investor hurt by one of them could sue, and probably win if the mispricing were obvious and the motive clear. The law requires a manager to worry about the terms of financing; we think it encourages the manager to look at financing from the viewpoint of the *passive* investor.

Consider the altered instructions: 'Take all positive-NPV projects, and issue securities at a fair price conditional on market information only.' In other words, managers should use their special information about investments, but ignore it when it comes to financing.²³ However, these instructions are still not fully credible, not only because of the mental discipline required, but also because managers' *personal* interests are likely to be more closely aligned with *old* stockholders' interests than with new stockholders'.

Consider a manager who is also a stockholder. If he always buys *and holds* a pro rata share of any new issue, and maximizes the intrinsic value of his holdings, then his interests will be aligned with all securityholders', and he will maximize the intrinsic value of the firm.

However, most managers would not want to buy a pro rata share of every new issue, even if the issue is fairly priced from their point of view. The reasons why can be traced to the same portfolio considerations which prevent old stockholders from buying all of every new issue – loss of diversification and, in extreme cases, limits to personal wealth. If the manager does not buy all of

²² Existing securityholders could protect against this ripoff by taking a pro rata share of each new issue. But this would be cumbersome at best. It would also invite a different kind of ripoff, in which outside securityholders buy an overpriced issue while insiders and their friends sell or sell short.

²³ This suggests the idea that managers could avoid conflicts between old and new shareholders by *concealing* the firm's investment decision. Take case II in table 2, where the firm has ample slack. Suppose its investment decision is not revealed until $t = +1$. Then the firm's actions prompt no trading at $t = 0$, and good investment opportunities are not bypassed. In case I, on the other hand, the investment decision cannot be concealed because a stock issue necessarily comes first.

every new issue then his interests as a shareholder are those of an (informed) old shareholder.

There is still another complication: a manager-shareholder who has inside information will be tempted to trade on it. If the outside market is (semi-strong form) efficient, the manager will want to sell half the time and buy the other half. In particular, he will want to abstain from half of new issues, and buy more than a pro rata share of the others. He will also want to buy or sell if the firm does not issue. The potential trading profit will depend on the issue-invest decision, although apparently not in any tractable way. We doubt the managers' interests will be aligned with any outside investor's if the managers are given free rein to trade on personal account.

4.3. *Empirical evidence*

It is easy to see why managers should take all positive-NPV projects, but hard to build a completely convincing theory explaining why they would always do so. We think it more likely that managers having superior information act in old stockholders' interest. We also think that existing empirical evidence supports our view.

If management acts in old shareholders' interests, our model predicts that the decision to issue and invest causes stock price to fall. If management took all *and only* positive-NPV projects, even when issuing and investing reduces the intrinsic value of the 'old' shares, the same decision would either increase stock price or leave it unchanged. The decision to invest would reveal the existence of an attractive project (i.e., $b > 0$). This is good news, unless investors knew for sure that the firm would have that investment opportunity. It cannot be bad news in any case.

Recent papers by Korwar (1982), Asquith and Mullins (1983) and Dann and Mikkelsen (1984) show significant negative average price impacts when a new stock issue is announced. 'Information effects' are an obvious explanation. However, as far as we know, ours is the only complete model explaining how such an information effect could occur in a rational expectations equilibrium.

Of course our model predicts that stock prices will *always* fall when investors learn of a new stock issue. But the model holds everything but the issue-investment decision constant. In particular, it ignores the flow to investors of other information about the firm's prospects. This flow creates a random error in any measurement of how a stock price changes in response to a specific event.

If our interpretation of these results is accepted, we can set aside, at least for the present discussion, models assuming managers simply 'accept all positive-NPV projects'.

If managers act in old shareholders' interests, do they assume those shareholders are passive or active? Do they just maximize the existing shares' value,

or do they work out how rational shareholders' portfolio choices depend on their decisions?

These questions can also be answered empirically. If managers assume active shareholders, then only the investment decision matters. Good investments are foregone even when the firm has plenty of cash to pay for them. However, if managers assume passive stockholders, then financing matters and firms will adapt their financing policy to mitigate the loss in value from foregone investment opportunities. For example, managers will try to build up financial slack on order to avoid situations in which a security issue is required to finance a valuable investment opportunity. If information asymmetries relate primarily to firm value, rather than risk, managers will favor debt over equity financing if external capital is required.

In our framework, the 'passive investor' assumption gives a variety of interesting hypotheses about corporate financing. That is why we use the assumption for most of this paper's formal analysis.

We noted that Dann and Mikkelsen (1984) found a significant negative average price impact when *stock* issues are announced. They also looked at a sample of debt issues, and found *no* significant price impact. Our model may be able to explain this difference.²⁴

The 'passive investor' assumption implies that stock price falls when stock is issued. However, stock price should *not* fall if default-risk-free debt is issued, because the ability to issue risk-free debt is equivalent to having ample financial slack, and having ample slack insures that the firm will take all positive-NPV projects. Thus, in our model the only information conveyed by the decision to issue risk-free debt and invest is that the firm has a positive-NPV project. This causes a *positive* price change unless the project's existence was known beforehand.

Under the 'active investor' assumption, the decision to invest would be bad news, and the choice of debt over equity financing would not make the news any better. Choosing this assumption would give us no way to explain Dann and Mikkelsen's results.

Of course, the debt issues examined by Dann and Mikkelsen were not literally default-risk-free. But if the probability of default on these issues was small, their negative 'information effect' should likewise be small.²⁵

5. Extensions and implications

Having explained our model formally, and having discussed its assumptions and some of its empirical implications, we can now turn to a few extensions,

²⁴Miller and Rock's model would predict the same negative stock price impact regardless of the type of security issued.

²⁵You would expect that the riskier the instrument issued, the greater the issues' impact on the market value of the firm. However, we have not been able to prove that this positive relationship is always monotonic.

qualifications, and further observations.²⁶ We specifically address two questions:

- (1) What happens when the information asymmetry is temporary and what happens when it is permanent but the firm has no immediate need for funds, except to build up slack?
- (2) What does our model say about mergers?

Discussing these questions leads us to other issues, for example, the implications of managers' superior information for dividend policy.

5.1. An easy way out

There is of course an easy way out of the problems described in this paper – an easy way to avoid any loss of market value: just issue stock at $t = -1$, when managers and the market are assumed to share the same information. That is one lesson of our model. If managers know more than the market does, firms should avoid situations in which valuable investment projects have to be financed by stock issues. Having slack solves the problem, and one way to get slack is to issue stock when there is no asymmetric information.

That is not an easy way out, however, if the information asymmetry is permanent. Suppose managers are always one period ahead of the market. At $t = -1$, for example, managers would know \bar{A} and \bar{B} , but investors would not. Investors at $t = -1$ would see \bar{A} and \bar{B} as random variables. At $t = 0$, they would find out the means \bar{A} and \bar{B} (and the underlying distributions of \tilde{A} and \tilde{B}) but by that time managers would know the realizations a and b .

Assume the firm has insufficient slack to undertake the project, and also, to keep things simple, that the amount of slack is fixed unless equity is issued to increase it and the investment required to undertake the project is known. Consider the decision to issue $E = I - S$ dollars of stock at $t = -1$. If the firm does *not* issue, its true value at $t = -1$ is

$$V_{\text{old}}(\text{no issue}) = \bar{A} + \bar{B} + S - L,$$

where L is the ex ante loss in firm value attributable to insufficient slack. That is, L reflects the probability the firm will choose to pass up a positive-NPV investment at $t = 0$, and the loss in value if it does. Of course, investors do not know how big L is, because they do not know the distributions of \tilde{A} and \tilde{B} . However, they do know that L goes to zero if the firm issues stock at $t = -1$

²⁶ Our model includes the assumption that managers act in old stockholders' interests, and that those stockholders are passive in the sense discussed above.

in order to raise the additional cash $E = I - S$ needed to assure investment at $t = 0$.

This brings us back to the same problem we started with in section 2. We have an 'asset-in-place' worth $\bar{A} + \bar{B} + S - L$ and an 'investment opportunity' worth L . Managers know these values but investors have only probability distributions. Thus, the firm's decision to issue and the price investors are willing to pay are governed by eqs. (1) and (2). Managers may or may not issue stock at $t = -1$: it depends on the price they can issue it for. If investors are too pessimistic, relative to what managers know, managers may accept the ex ante loss L and take a chance that the firm will be able to issue and invest at $t = 0$ if the NPV of its investment opportunity turns out positive.

We will not here pursue analysis of the optimal issue strategy in this dynamic setting. However, we have shown that the problems addressed in this paper do not go away when the firm has no immediate real investment opportunity. Given asymmetric information, a firm with valuable future real investment opportunities is better off with slack than without it. Moreover, it should build up slack through retention rather than stock issues. This is consistent with actual retention policies of most public firms, which limit dividends so that they will rarely have to go to the market for fresh equity.

Thus we add one item in favor of the list of possible arguments for dividend payouts low enough to avoid reliance on external equity financing. On the other hand, dividends would alleviate the problems posed in this paper if they help signal the true value of \tilde{A} , thus reducing σ_A . However, this is not necessarily an argument for high average payout; it merely supports payout policies with a high correlation of changes in dividends and changes in the value of assets in place. This could explain why dividend payments respond to changes in earnings, not market value, if book earnings primarily reflect the performance of assets-in-place.

At this point, we revert to our original three-date model, in which asymmetric information is important only at $t = 0$.

5.2. Mergers

Our model's main message is this: given asymmetric information, a firm with insufficient financial slack may not undertake all valuable investment opportunities. Thus, a firm that has too little slack increases its value by acquiring more.

One way to do this is by merger. In our model, a merger always creates value when one firm's surplus slack fully covers the other's deficiency.²⁷ Of course

²⁷If the merged firms' total slack does not fully cover their investment requirements, the merger may or may not increase value. See Majluf (1978, pp. 239–256).

this gain is only one of dozens of possible merger motives. But we have nothing to say here about other benefits or costs, so we will assume them away here.

It turns out that the same conditions that create a potential gain from transferring surplus slack between merger partners will also complicate the merger negotiations, and in some cases rule out any possibility of their successful completion. Consider a firm with an existing business, a good investment opportunity, but insufficient slack to pay for it. It seeks a merger with a cash-rich firm. The would-be buyer only knows the distributions of \bar{A} and \bar{B} , not the true values a and b .

Let Q' be the proposed merger price. That is, if the merger offer is accepted, the shareholders of the cash-poor firm receive Q' in cash or shares.²⁸ If the offer is turned down, that firm's shareholders forego the investment and are left with $S + a$. Thus, given a and b , the offer will be accepted if $Q' \geq S + a$. However, the cash-rich firm will only offer $Q' = S + \bar{A}(N') + \bar{B}(N')$, where $\bar{A}(N')$ and $\bar{B}(N')$ are the expectations of \bar{A} and \bar{B} conditional on observing that the cash-poor firm is willing to go through with the deal.

Under these assumptions, the merger would never occur. The cash-poor firm can always do better by issuing stock directly to investors, because P' always exceeds Q' .²⁹

In our model, the decision to sell shares always carries negative information, regardless of whether the shares are sold to investors generally or to a specific acquiring firm. The buyers or buyers discount the shares so that cost equals expected payoff. If the firm issues $E = I - S$, old shareholders retain a stake, but if their firm is sold they are completely disengaged from it. The decision to sell all of the firm via merger, rather than issue the fraction $E/(P' + E)$, drives down market price below P' , because the firm has chosen to sell more stock than absolutely necessary to cover the investment I . [We assume that (1) the acquiring firm's slack exceeds the selling firm's deficiency ($I - S$), (2) the acquiring firm has other assets, and (3) everyone knows what these assets are worth.]

²⁸We assume for simplicity that the true value of any shares used to finance the merger is independent of a and b . A more elaborate analysis is needed if they are not independent. A further complication is introduced if (1) the merger is financed by shares and (2) the buying firm's management has superior information about what those shares are worth.

²⁹A proof follows. Define $a^*(N')$ as the breakeven value of a , the value at which the cash-poor firm is just indifferent to being acquired at the equilibrium price Q' . Note that $Q' = a^*(N') + S$. Refer again to the requirement for the firm to issue stock (1'), $E/P'(S + a) \leq E + b$. If P' were equal to Q' , the firm would issue and invest at $a^*(N')$ for any $b > 0$. That is, if $P' = Q' = S + a^*(N')$,

$$\frac{E}{P'}(S + a) = \frac{E}{S + a^*(N')} (S + a^*(N')) = E < E + b.$$

Thus $a^*(M')$, the breakeven value of a at which the firm is just willing to issue stock, exceeds $a^*(N')$ for any $b > 0$. Thus,

$$\bar{A}(M') + \bar{B}(M') > \bar{A}(N') + \bar{B}(N') \quad \text{and} \quad P' > Q'.$$

Negotiated mergers thus seem to be ruled out (in this simple case) regardless of financing, because the cash-poor firm can always do better by issuing stock. How can mergers be explained under the premises of this paper?

There are two possible explanations. First, there may be partial or total disclosure of internal information during negotiation.³⁰ Second, the merger may go through if the buyer rather than the seller takes the initiative. In our model, firms with plenty of slack should seek out acquisition targets which have good investment opportunities and limited slack, and about which investors have limited information. Such firms sell at a discount from their average potential value $\bar{A} + \bar{B} + S$.³¹ A tender offer made directly to the slack-poor firm's shareholders, at a price above $\bar{A} + \bar{B} + S - L$, but below $\bar{A} + \bar{B} + S$, makes both the bidder and the target's shareholders better off *ex ante*, although neither buyer nor sellers know the true value $a + b + S$. A cash tender offer conveys no bad news about $a + b + S$, so long as the target's management are not accomplices. Perhaps this explains why most mergers are initiated by buyers. A firm that actively seeks to be bought out may end up a wallflower. The more actively management seeks to sell, the less an outsider will assume their firm is worth.

6. Conclusion

We have presented a model of the issue-invest decision when the firm's managers have superior information. We can sum up by reviewing some of the model's most interesting properties:

(1) It is generally better to issue safe securities than risky ones. Firms should go to bond markets for external capital, but raise equity by retention if possible. That is, external financing using debt is better than financing by equity.

(2) Firms whose investment opportunities outstrip operating cash flows, and which have used up their ability to issue low-risk debt, may forego good investments rather than issue risky securities to finance them. This is done in the existing stockholders' interest. However, stockholders are better off *ex ante* – i.e., on average – when the firm carries sufficient financial slack to undertake good investment opportunities as they arise.

The *ex ante* loss in value increases with the size of the required equity issue. Thus, increasing the required investment or reducing slack available for this investment also increases the *ex ante* loss. In addition, numerical simulations

³⁰The cash-poor firm would prefer to negotiate with a firm that is not a competitor. A competitor might back out of the negotiations and take advantage of information acquired in them. This hazard is less in a 'conglomerate' merger.

³¹We assume the target firm has not yet declared its issue-invest decision.

indicate the loss decreases when the market's uncertainty about the value of assets in place is reduced, or when the investment opportunity's expected NPV is increased.

(3) Firms can build up financial slack by restricting dividends when investment requirements are modest. The cash saved is held as marketable securities or reserve borrowing power.

The other way to build slack is by issuing stock in periods when managers' information advantage is small; firms with insufficient slack to cover possible future investment opportunities would issue in periods where managers have no information advantage. However, we have not derived a generally optimal dynamic issue strategy.

(4) The firm should not pay a dividend if it has to recoup the cash by selling stock or some other risky security. Of course dividends could help convey managers' superior information to the market. Our model suggests a policy under which changes in dividends are highly correlated with managers' estimate of the value of assets in place.³²

(5) When managers have superior information, and stock is issued to finance investment, stock price will fall, other things equal. This action is nevertheless in the (existing) stockholders' interest. If the firm issues safe (default-risk-free) debt to finance investment, stock price will not fall.

(6) A merger of a slack-rich and slack-poor firm increases the firm's combined value. However, *negotiating* such mergers will be hopeless unless the slack-poor firms' managers can convey their special information to the prospective buyers. If this information cannot be conveyed (and verified), slack-poor firms will be bought out by tender offers made directly to their shareholders.

Of course, the six items stated just above depend on the specific assumptions of our model and may not follow in other contexts. We have only explored one of many possible stories about corporate finance. A full description of corporate financing and investment behavior will no doubt require telling several stories at once.

References

- Akerlof, G.A., 1970, The market for 'lemons': Quality and the market mechanism, *Quarterly Journal of Economics* 84, 488-500.
- Asquith, P. and D.W. Mullins, 1983, Equity issues and stock price dilution, Working paper, May (Harvard Business School, Cambridge, MA).
- Bhattacharya, S., 1979, Imperfect information, dividend policy and the 'bird in the hand fallacy', *Bell Journal of Economics* 10, 259-270.
- Bhattacharya, S. and J.R. Ritter, 1983, Innovation and communication: Signalling with partial disclosure, *Review of Economic Studies* 50, 331-346.

³² However, there is no mechanism in our model to insure that such a policy would be faithfully followed.

- Campbell, T.S., 1979, Optimal investment financing decisions and the value of confidentiality, *Journal of Financial and Quantitative Analysis* 14, 913-924.
- Campbell, T.S. and W.A. Kracaw, 1980, Information production, market signalling, and the theory of financial intermediation, *Journal of Finance* 35, 863-882.
- Dann, L.Y. and W.H. Mikkelson, 1984, Convertible debt issuance, capital structure change and financing-related information: Some new evidence, *Journal of Financial Economics*, this issue.
- Downes, D.H. and R. Heinkel, 1982, Signalling and the valuation of unseasoned new issues, *Journal of Finance* 37, 1-10.
- Galai, D. and R. Masulis, 1976, The option pricing model and the risk factor of stock, *Journal of Financial Economics* 3, 53-82.
- Giammarino, R.M. and E.H. Neave, 1982, The failure of financial contracts and the relevance of financial policy, Working paper No. 82-3 (Queen's University, Kingston, Ont.).
- Grossman, S.J., 1981, An introduction to the theory of rational expectations under asymmetric information, *Review of Economic Studies* 48, 541-559.
- Grossman, S.J. and O.D. Hart, 1981, The allocational role of takeover bids in situations of asymmetric information, *Journal of Finance* 36, 253-270.
- Hess, A.C. and P.A. Frost, 1982, Tests for price effects of new issues of seasoned securities, *Journal of Finance* 36, 11-25.
- Jensen, M.C. and W. Meckling, 1976, Theory of the firm: Managerial behavior, agency costs and capital structure, *Journal of Financial Economics* 3, 305-360.
- Korwar, A.N., 1981, The effect of new issues of equity: An empirical examination, Working paper (University of California, Los Angeles, CA).
- Leland, H. and D. Pyle, 1977, Information asymmetries, financial structure and financial intermediaries, *Journal of Finance* 32, 371-387.
- Majluf, N.S., 1978, Study on mergers: A rationale for conglomerate mergers, Unpublished Ph.D. dissertation (MIT, Cambridge, MA).
- Miller, M.H. and K. Rock, 1982, Dividend policy under asymmetric information, Working paper, Nov. (Graduate School of Business, University of Chicago, Chicago, IL).
- Myers, S.C., 1977, Determinants of corporate borrowing, *Journal of Financial Economics* 5, 147-175.
- Myers, S.C. and N.S. Majluf, 1978, Stock issues and investment policy when firms have information investors do not have, Working paper (Sloan School of Management, MIT, Cambridge, MA).
- Rendleman, R.J., 1980, Information asymmetries and optimal project financing, Working paper (Graduate School of Business, Duke University, Durham, NC).
- Ross, S.A., 1978, Some notes on financial-incentive signalling models, activity choice and risk preferences, *Journal of Finance* 33, 777-792.
- Ross, S.A., 1977, The determination of financial structure: The incentive-signalling approach, *Bell Journal of Economics* 8, 23-40.
- Smith, C.W., and J.B. Warner, 1979, On financial contracting: An analysis of bond covenants, *Journal of Financial Economics* 7, 117-161.
- Stiglitz, J.E., and A. Weiss, 1981, Credit rationing in markets with imperfect information, Part I, *American Economic Review* 71, 393-410.