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ABSTRACT

We explain the observed negative relation between market value of firms and their fund raising activities. Ours is not a signalling model. The firm's objective is to maximize the present value of its income. Considerations of cash availability (liquidity) and unfolding of uncertainty drive our model. Income from operations is an important source of liquidity. Low earnings are associated with low liquidity. Whether earnings are low or not is known to some extent in advance of the realization itself. External financing is pursued in anticipation of the earnings' realization in order to maintain a desired level of liquidity. Therefore, anticipated low earnings are associated with a high level of external financing. Of course, an anticipation of low earnings is also accompanied by a decrease in the firm's value. The empiricist who looks at time series of a firm's value and of its dividend/external financing announcements would then record positive correlation between value and cash distributions and negative correlation between value and external financing.

A NAIVE STUDENT OF CORPORATE FINANCE may think that money is raised by a firm after it detects positive net present value projects in which it wishes to invest the money. This logic leads to the empirical prediction that external financing should be accompanied by an increase in the firm's market value. The observed phenomenon is the opposite one, namely that when firms raise money, their equity value drops. (See Huart (1980), Dann and Mikkelson (1984) and Asquith and Mullins (1983b) for the empirical evidence.) It has also been documented that unexpected cash distributions to security holders are accompanied by increases in the distributing firm's market value. (See Aharony and Swary (1980), Asquith and Mullins (1983a), Brickley (1983) and Handjinicolaou and Kalay (1984) for evidence on dividend payments. Evidence on share repurchase is provided by Dann (1981), Vermaelen (1981) and Masulis (1982).) We present a model which is consistent with these observed phenomena. Our argument is based on liquidity and temporal resolution of uncertainty, but not on signalling motives, taxes, bankruptcy or conflicts among security holders.

Frequently, funds required to make an investment have to be found quickly by the investing firm or the investment's value decreases. In extreme cases projects have the characteristic of "now or never." Unless the money for the project is available at the time the project is found, the opportunity to invest disappears.

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In this situation a firm is induced to hold highly liquid assets. It keeps the funds until the investment opportunity arises. Such policy is of course optimal when no liquidity premium has to be paid on the liquid assets. It may still be optimal to hold liquid assets even when the rate of return on them is lower than the market's rate of return on less liquid assets with similar risk characteristics.

The amount of liquid assets held by the firm depends on the anticipated future requirements. These requirements cannot be accurately forecast and they are stochastic in nature. As management learns about the firm's need for funds, adjustments in the firm's liquid assets position are made.

We present a simple model incorporating the need for cash in advance of an investment, a relatively low rate of return on liquid assets and a dynamic readjustment of the liquid asset balance. This rebalancing is done by paying out dividends or by raising cash. In our simple model dividend policy is relevant. Therefore one can learn about the firm's real side from the dividend decision. Nonetheless, this is not a signalling model in that nobody cares to transmit information. Information transmission is incidental and unintentional. Management's objective is to maximize the present value of the firm's income. Management does not worry about the perceived value of the firm, yet financing activities convey inside information.

Our model is consistent with the observed negative relation between fund raising and firms' value. In it, the firms' fund raising and news about future earnings are negatively related. When it is known that future earnings will be low, the firm goes to the capital market in order to maintain the desired level of liquidity (which is needed to finance projects). When examining data on stock prices and fund raising activities only, the two are negatively correlated. In this paper, "dividend payment" means any cash distribution to security holders, including the repurchase of outstanding securities. Similarly, "cash raising" should be interpreted as issuing of securities (stocks, bonds or any more exotic securities). Our model abstracts from bankruptcy and tax considerations. Therefore, outside financing comes in its simplest form, namely riskfree debt.

In an earlier paper, Miller and Rock (1982) note the unifying theme among the empirical results cited above, namely that outside financing and stock value are negatively correlated. They provide a similar model to the present one and proceed to study the implications of asymmetric information. In section IV below we compare their paper with the present one.

In the next section we discuss liquidity. In section II we present the model. We analyze it in section III and discuss our results in section IV.

I. Liquidity

Should the firm use its own funds ("retain earnings") or appeal to the capital market when it wishes to invest in a project? In the world of Miller and Modigliani (1961) capital markets are perfect to the extent that security holders' wealth is unaffected by the firm's answer to the question. Capital market perfection means, among other things, the absence of liquidity problems. All assets can be instantaneously exchanged for cash and vice versa. The exchange is made at the market value and entails no loss.

One can see a variety of reasons why real world markets are not quite perfect. For instance, consider firms wishing to finance new projects by issuing claims on the projects. If the claims are risky and if the firms know more about the projects than the outside world knows, a market collapse a la Ackerlof (1970) may take place. Firms believing their projects are good will perceive that their claims are undervalued by the market and will not issue such claims. Only projects of pessimistic firms will be financed.

An attempt to convince the market that a claim on a project is worth more than what is perceived by the market may be counter productive. Such a persuasion campaign takes time, and entails the dissemination of information. Each one of these can amount to a deterioration in the project's value because information which becomes public can be used by competitors. Bhattacharya and Ritter (1983) have a model which explores this idea.

All in all, under certain circumstances it is best that a firm uses its own liquid assets to invest quickly without going to the capital market. Thus, liquidity is desirable. It is also costly. The exact nature of liquidity costs is difficult to ascertain. One can speculate that holding of liquid assets (e.g., treasury bills) implies a tax liability. Another possibility is that liquid assets create more severe agency problems than nonliquid assets. Liquidity of an asset is closely related to the reversibility of the investment in it. Thus, management of a liquid asset can more easily and less visibly use that asset to advance its interest at the expense of the asset's owners. Therefore, careful contracting and monitoring are required. These are expensive arrangements.

As an empirical matter, firms' liquid assets are not huge. Current assets minus inventories are roughly equal to current liabilities on the firms' balance sheets. Substantial additional liquidity is provided by the establishment of credit lines. Shohet and Rikert (1982) survey 600 annual reports. Out of these, 544 firms reported they had credit lines. Typically, these credit lines are substantial relative to the companies' sizes and they entail ¼%–½% annual fee on the unused portion of the line. The establishment of a compensating balance is another popular way of paying for a credit line. An interpretation of the commitment fee is as a payment for the option to borrow. That firms pay for this option suggests that the option is valuable to them. Apparently, this option spans opportunities which are otherwise missing from our less than perfect capital markets. Table I illustrates the relative magnitudes of firms' assets, their current assets, their current liabilities, their credit lines and their dividend payments. It is noteworthy that much of the credit facility is unused most of the time. The size of the credit lines and their costs suggest that liquidity is both important and costly.

The interaction among the firm's investment opportunities, liquid position and earnings takes place continuously. Once in a while the firm learns something about its investment opportunities or about earnings from existing investments. An investment opportunity can be the requirement to pump money into an existing project lest its value deteriorate considerably. Occasionally, an investment opportunity has to be exploited quickly or quietly. Then the firm draws on its liquid funds. Therefore, liquidity is maintained. Earnings from existing projects provide some of the liquidity. Earnings are the least costly source of liquidity compared to a credit line or perhaps even marketable securities.

Table I

Selected Data on Four Corporations. (in millions of dollars) *Source.* Annual Reports of the Corporations.

Name	Alexander and Baldwin, Inc.[1]	SCM Corporation[2]	American Standard Inc.[3]	Beatrice Foods[4]
Year Ended	12/31/82	6/30/82	12/31/82	2/28/82
Total Assets	713	1,124	1,520	4,744
Current Assets	183	663	802	2,179
Inventories	29	349	289	965
Current Liabilities	72	312	491	1,258
Credit Line	100[5]	100	180.4	579[6]
Unused Credit	100	100	150.4	169[7]
Commitment Fee	N.A.	3/8%	N.A.	1/4%–1/2%
Dividends	17	19	56	154

[1] A diversified corporation operating mostly in Hawaii.

[2] A diversified manufacturer of consumer and industrial products.

[3] An international manufacturer of transportation products, building products, security and graphic products, and construction and mining equipment.

[4] A diversified food company.

[5] Replacing a \$31m credit line agreement for 1981 and 1982. The only borrowing under this agreement during both years consisted of a 15-day loan for \$10m at the prime interest rate.

[6] Includes \$250m committed lines of credit and \$329m informal lines of credit.

[7] The unused portion of the informal lines of credit is \$169m. The amount of unused portion of the committed credit line is not reported.

Our model is highly stylized, being a discrete two period two projects model. To capture the essence of the need for liquidity we constrain investment in one of the projects to be only out of the firm's existing funds. That is, the firm cannot raise money and immediately invest it in that project. Moreover, to capture the costly aspect of liquidity we assume that the second project is riskless but earns less than the market's risk free rate. (This is the Clower (1967) constraint which has been useful in macroeconomic models.) That second project is called the firm's liquid asset, although the firm's liquid pool is its income from both projects. A firm which acts optimally updates the stock of liquid assets as uncertainty over future uses and sources unfolds. This updating policy is the paper's focus. The model's most important features are:

1. Investment in at least one project can be made only with the money on hand.
2. The liquid asset's return is lower than the market's.
3. Future earnings are uncertain, but some of the uncertainty is resolved prior to the realization of the random variables.
4. Investment opportunities are certain.

II. The Model

Our model has two periods. At the beginning of each period the firm pays off the debt which is due. The remaining funds are allocated among three uses: dividend payment, investment in a project and investment in a liquid asset. The firm can also raise funds (e.g., issue bonds) and invest these funds in the liquid asset (but not in the project). The period ends with the collection of the money from the two investments. This money is the liquid stock of the next period. It will be used to serve the debt due, to pay dividends and to make new investments. At the last period's end all debt is paid off and the remaining cash is distributed as liquidating dividend. Liability is unlimited and negative distribution of liquidating dividend is possible. The firm is neutral to risk and makes decisions so as to maximize the present value of the expected dividend stream.

The rate of return at which expected dividends are discounted is $\bar{R}$ per period. This is the firm's borrowing rate and the rate at which it discounts future dividend payments. The firm's liquid asset's rate of return is $\bar{r}$ per period. Of course, $\bar{r} < \bar{R}$. Investment of I dollars in the firm's risky project gives $[f(I) + \tilde{x} + \tilde{y}]$ dollars at the period's end. The variables $\tilde{x}$ and $\tilde{y}$ are random, independent of each other and independent across periods. The value of $\tilde{x}$ is known at the beginning of the period whereas the value of $\tilde{y}$ is known only at the period's end. The production function f is increasing at a decreasing rate.

Consider a firm which has C dollars in cash *after* it has paid off the debt due at the period's beginning. It distributes $D \geq 0$ as dividends to the owners, invests I in the risky project and invests the remaining cash, $C - (I + D)$, in the liquid assets (naturally, $I + D \leq C$). Another activity is issuing new debt of $b \geq 0$. Issuing b in new debt has two consequences. The firm owes $b(1 + \bar{R})$ to its creditor and has extra $b(1 + \bar{r})$ in cash at the period's end. The firm cannot invest the borrowed money in the risky project at the period's beginning. With the decision (b, D, I), the firm's cash at the period's end is

$$f(I) + \tilde{x} + \tilde{y} + (C - (I + D) + b)r, \qquad \text{where } R \equiv 1 + \bar{R} \quad \text{and} \quad r \equiv 1 + \bar{r}. \tag{1}$$

The money available for investment and dividend payment is last period's earnings minus the debt service. If the firm borrowed b, for one period only, it would earn br but would have to pay back $bR > br$, without enjoying the benefit of improving its liquidity. Thus, circumstances dictate that all borrowings are made for at least two periods. Note that the firm can roll over debt, thereby producing the effect of a long term debt. Therefore we confine attention to bonds which mature two periods after they are issued. Thus, features of a finite horizon model can be studied within the simple world of a two period horizon.

Let us consider the firm as it enters the last period having C_1^e in cash (superscripts b and e stand for beginning and end, respectively). It owes b_0R^2 to be paid immediately and b_1R to be paid (as b_1R^2) at the period's end, where b_j is the amount the firm raised at the beginning of period j. (We do not consider decisions which are made in period zero, but we use the parameters from that period as convenient initial values.) The net amount at the firm's disposal is $C_2^b = C_1^e - b_0R^2$. Suppose the firm chooses the policy (b, D, I). The expected value of the dividend stream is

$$D + \frac{1}{R}\int [f(I) + x + y + (C_2^b - I - D + b)r - R(b + b_1R)]g(\tilde{y})\, d\tilde{y}.$$

The function g is the density function of the random variable $\tilde{y}$. (Note that the last period's value of x is not random when the choice of the last period's (b, D, I) is made.) The last period's optimization problem is to determine

$$F_2(C_2^b, b_1, x) = \text{maximum}_{b,D,I}\left\{D + \frac{1}{R}\int [f(I) + x + \tilde{y} + (C_2^b - I - D + b)r - (b + b_1R)R]g(\tilde{y})\, d\tilde{y}\right\}, \tag{2}$$

subject to

$$0 \leq D, \tag{3}$$

$$D + I \leq C_2^b, \tag{4}$$

$$0 \leq b. \tag{5}$$

The problem (2)–(5) is simple and its analysis is provided in the sequel. The value function $F_2(C_2^b, b_1, x)$ is the firm's value at the beginning of period 2, if it holds C_2^b in cash (after debt service), will have to pay b_1R^2 at the period's end to its creditors, and the realization of the random variable $\tilde{x}$ is x. We can now define a similar value function for period one, namely

$$F_1(C_1^b, b_0, x_1) = \text{maximum}_{b,D,I}\left\{D + \frac{1}{R}\int F_2(\tilde{C}_2^b, b, \tilde{x})h(\tilde{x})g(\tilde{y})\, d\tilde{x}\, d\tilde{y}\right\}, \tag{6}$$

subject to

$$0 \leq D, \tag{7}$$

$$I + D \leq C_1^b, \tag{8}$$

$$0 \leq b, \tag{9}$$

$$\tilde{C}_2^b = f(I) + x_1 + \tilde{y} + (C_1^b - I - D + b)r - b_0R^2. \tag{10}$$

The function h is the density function of the random variable $\tilde{x}$. Equation (10) is an accounting identity indicating how C_2^b comes about.

A Simple Example

A simple form of our model is analyzed below. In this simple form, future liquidity considerations do not affect the optimal investment in the risky project. Nonetheless, the simple form is readily understood and illustrates the negative relation between the firm's value and its financing. The simplification is obtained by assuming that $\tilde{y} = 0$ and that

$$f(I) = \begin{Bmatrix} IG & I \leq \bar{I} \\ \bar{I}G & I \geq \bar{I} \end{Bmatrix}, \tag{11}$$

where G satisfies

$$G \geq R^2/r. \tag{12}$$

Given (11)–(12) and $\tilde{y} = 0$, the solution to (2)–(5) is straightforward now, namely

$$b_2 = 0, \qquad I_2 = \min\{\bar{I}, C_2^b\} \quad \text{and} \quad D_2 = C_2^b - I_2. \tag{13}$$

The firm's value is

$$F_2(C_2^b, b_1, x_2) = D_2 + [f(I_2) + x_2 - b_1R^2]/R = \begin{cases} C_2^b - \bar{I} + [\bar{I}G + x_2 - b_1R^2]/R & C_2^b \geq \bar{I} \\ [C_2^bG + x_2 - b_1R^2]/R & C_2^b \leq \bar{I} \end{cases}. \tag{14}$$

The equality $b_2 = 0$ follows from the fact that the model has only two periods and there is no need for investment past the second period. The optimal investment in the second period, I_2, equals $\bar{I}$ if the resources are available, namely if $C_2^b \geq \bar{I}$. In this case all residual funds, $C_2^b - \bar{I}$ are distributed to the shareholders. The realized value of x in the second period, x_2, is irrelevant when the optimal investment and financing decisions are made.

The first period problem is described by (6)–(10). It is different from the second period problem in that the realized value of x, x_1, is important in determining the optimal amount of money to be raised, b_1, and the optimal dividend D_1. To solve the first period problem, note first that it is optimal to set

$$I_1 = \begin{cases} \bar{I} & C_1^b \geq \bar{I} \\ C_1^b & C_1^b \leq \bar{I} \end{cases} \tag{15}$$

Let $i = \{\bar{I} - [f(I_1) + x_1 - b_0R^2]\}/r$. If $i > 0$ it is optimal to invest i in the liquid asset, thereby bringing C_2^b to equal $\bar{I}$. To see this, substitute (10) into (14) and then substitute (14) into (6). Recall (12) to complete the argument that it is optimal to set b_1 and D_1 so as to satisfy the equality

$$b_1 - D_1 = [\bar{I} - (f(I_1) + x_1 - b_0R^2)]^+/r - (C_1^b - I_1), \tag{16}$$

where $a^+ = \max\{a, 0\}$.

The important feature of (16) is that the net (of dividend) amount to be raised, $b_1 - D_1$, is negatively related to the variable x_1. It is straightforward to check that the firm's value, F_1, is positively related to the variable x_1.

The simple form of the model indicates how financing and value are negatively related. The full model is studied in the next section to explore how real investment decisions can also be affected by the cash in advance constraint.

III. Analysis

The model's formulation and presentation as well as the analysis are inspired by standard dynamic programming ideas. We look briefly at the last period optimal investment policy and then analyze the investment/finance decision of the next to last period. The main findings are summarized at the section's end.

In the last period the firm faces the problem defined by (2)–(5). Its solution is straightforward. The firm maintains no liquid assets in the last period because once the period is over, there will be no need for liquidity. Therefore $b = 0$ and $I + D = C$. The investment policy is chosen according to the Fisherian paradigm, so the optimal investment I satisfies $I = \bar{I}$ if $\bar{I} \leq C$ and $I = C$ otherwise. The quantity $\bar{I}$ is the investment level which satisfies $f'(\bar{I}) = R$. These observations imply that

$$F_2(C, b, x) = \left\{ \begin{array}{ll} \dfrac{x + \bar{y} - bR^2 + f(C)}{R} & C \leq \bar{I} \\ C - \bar{I} + \dfrac{x + \bar{y} - bR^2 + f(\bar{I})}{R} & C \geq \bar{I} \end{array} \right\}, \qquad (17)$$

where $\bar{y}$ is the expected value of $\tilde{y}$.

Substitute (10) into (17) and then (17) into (6) to observe that the maximand in (6) depends on b and D only through the net borrowing of $b - D$. Therefore, we can obtain an equivalent problem in which the decision variables are $B = C - I - D + b$ and I. Constraints (7)–(9) imply that the transformed variables satisfy

$$I \leq C, \qquad (18)$$

and

$$0 \leq B. \qquad (19)$$

Moreover, given any triplet (B, C, I) which satisfies (18)–(19) one can set $D = C - I$ and $b = B$, and have an equivalent vector (b, C, D, I) satisfying (7)–(9). Thus, the following problem is equivalent to (6)–(10).

$$\text{Maximize}_{B,I} \left\{ C - I - B + \frac{1}{R} \int_{A^c} (\tilde{y} - Z) g(\tilde{y})\, d\tilde{y} \right.$$
$$\left. + \frac{1}{R^2} \int_A f(\tilde{y} - Z + \bar{I}) g(\tilde{y})\, d\tilde{y} + \frac{1}{R^2} \int_{A^c} f(\bar{I}) g(\tilde{y})\, d\tilde{y} \right\}, \qquad (20)$$

subject to (18)–(19); where $z = x - b_0R^2$, $Z = \bar{I} - f(I) - Br - z$ and the set A is realized when the firm lacks funds in the second period, i.e. $A = \{\tilde{y}: \tilde{y} \leq Z\}$ and A^c is its complement.

It is noteworthy that the objective function in (20) is concave in (B, I) and that the constraints (18) and (19) determine a convex set. Therefore, the first order conditions are necessary and sufficient for optimality. They are

$$rQ = 1 - \pi, \qquad (21)$$

and

$$f'(I)Q = 1 + \lambda, \qquad (22)$$

where λ and π are the multipliers associated with constraint (18) and (19), respectively, and

$$Q = Q(Z) = \frac{1}{R} \Pr\{\tilde{y} \geq Z\} + \frac{1}{R^2} \int_{\tilde{y} \leq Z} f'(\tilde{y} - Z + \bar{I}) g(\tilde{y})\, d\tilde{y}.$$

With the first order conditions on hand we first study the firm's behavior when it is optimal to invest in the liquid asset, that is when the optimal $B > 0$ (and therefore the multiplier $\pi = 0$). Compute

$$Q'(Z) = \frac{g(Z)}{R} - \frac{f'(\bar{I})g(Z)}{R^2} - \frac{1}{R^2}\int_{\tilde{y}\le Z} f''(\tilde{y} - Z + \bar{I})g(\tilde{y})\,d\tilde{y}$$

$$= -\frac{1}{R^2}\int_{\tilde{y}\ge Z} f''(\tilde{y} - Z + \bar{I})g(\tilde{y})\,d\tilde{y} > 0.$$

The equality is implied by $f'(\bar{I}) = R$ and the inequality follows from the concavity of the function f. Condition (21) and $\pi = 0$ imply that Q is a constant for all values of Z as long as $B > 0$. As $Z = \bar{I} - f(I) - Br - z$, its constancy can be assured only if I and B vary in tandem as functions of z. Therefore we have

Proposition 1. When $B > 0$ the following equality holds.

$$B = \frac{1}{r}(\bar{I} - f(I) - z - \hat{a}), \tag{23}$$

where $\hat{a}$ is a constant which does not depend on C or z.

When $B > 0$, either $\lambda = 0$ or $\lambda > 0$. Conditions (21)–(22) imply that when $\lambda = 0$ and $B > 0$, the optimal investment $\hat{I}$ satisfies $f'(\hat{I}) = r$. This should be expected. The optimal allocation of investment funds is such that the marginal rates of return are equal across projects. In particular, if the firm invests in liquid asset (i.e., $B > 0$) whose return is r and if sufficient funds are available (i.e., when $\lambda = 0$) when the optimal investment in the risky project $\hat{I}$ satisfies $f'(\hat{I}) = r$. The complementary case takes place when $C < \hat{I}$, in which case $\lambda > 0$ and the optimal investment size $I = C$ and $f'(C) > r$.

The preceding observations, straightforward calculations and the relation between (20) and (6) imply

Proposition 2. Consider the problem (6)–(10). Suppose it is optimal for the firm to invest something in the liquid asset (i.e., it is optimal to have either $C - (I + D) > 0$ or $b > 0$.) Then

$$F_1(C, b, x) = C - I + f(I) + \frac{x - bR^2}{r} + P(\hat{a}), \tag{24}$$

where

$$P(a) \equiv \frac{\bar{I} - a}{r} + \frac{\bar{x} + \bar{y}}{R} + \frac{1}{R}\int_{\tilde{y}\ge a}(\tilde{y} - a)g(\tilde{y})\,d\tilde{y}$$

$$+ \frac{1}{R^2}\int_{\tilde{y}\le a} f(\bar{I} + \tilde{y} - a)g(\tilde{y})\,d\tilde{y} + \frac{1}{R^2}\int_{\tilde{y}\ge a} f(\bar{I})g(\tilde{y})\,d\tilde{y},$$

and

$$P(\hat{a}) \ge P(a) \quad \text{for all } a.$$

Proposition 2 indicates that if investment of something in the liquid asset is optimal, the firm's value is linear in (C, x), as $P(a)$ does not depend on (C, x).

The constant $\hat{a}$ (which appears also in proposition 1) maximizes $P(a)$, so it satisfies $P'(\hat{a}) = 0$. Note that $P'(a) = \frac{1}{r} - Q(a)$, to check that $P''(\hat{a}) < 0$, so $P'(\hat{a}) = 0$ is indeed the equation determining $\hat{a}$.

Total differentiation of $P'(\hat{a}) = 0$ with respect to the rate of return r and indicate that the derivative of $\hat{a}$ with respect to r, $\hat{a}_r$, is negative. This enables us to make the intuitively appealing observation that the end of period value of money invested in the liquid asset (namely Br) increases with r. This observation follows from the negativity of $\hat{a}_r$ and of I_r and from differentiating Br with respect to r. (Recall that B is given by (23) and that $I_r = 0$ when $C < \hat{I}$ and $I_r < 0$ when $C > \hat{I}$.) That $\partial(Br)/\partial r > 0$ is intuitive: more is available from the liquid asset when it earns more.

To complete the analysis we turn to the investment policy when the firm elects to invest no money in the liquid asset. Let $I(z)$ be the solution to the first order condition (22) when $\lambda = 0$, i.e., $I(z)$ is the optimal first period investment if no investment is made in the liquid asset and if the firm is not cash constrained in the first period (so $I(z) \le C$). Recall that $f'(\tilde{y} - Z + \bar{I}) \ge R$ when $\tilde{y} \le Z$ to observe that $Q \ge 1/R$. This observation and (22) imply that

$$\frac{f'(I(z))}{R} \le 1. \tag{25}$$

Note that $f'(\bar{I})/R = 1$, $f'' < 0$ and (25) imply that $I(z) \ge \bar{I}$; unless the firm is cash constrained, it invests at least the amount it would invest in a world where there are no liquidity problems (i.e., where it is optimal to set $I = \bar{I}$). It may, however, choose to invest more than $\bar{I}$. To see this, totally differentiate (22) with respect to z (recalling that $B = 0$ now) to obtain

$$\begin{aligned}\frac{1}{R^2}\int_{\tilde{y}\le Z} f''(\tilde{y} - Z + \bar{I})g(\tilde{y})\,d\tilde{y} \\ + I'(z)\Bigg\{f''(I)\Bigg[\int_{\tilde{y}\ge Z} g(\tilde{y})\,d\tilde{y} + \frac{1}{R^2}\int_{\tilde{y}\le Z} f'(\tilde{y} - Z + \bar{I})g(\tilde{y})\,d\tilde{y}\Bigg] \\ + \frac{f'(I)}{R^2}\int_{\tilde{y}\le Z} f''(\tilde{y} - Z + \bar{I})g(\tilde{y})\,d\tilde{y}\Bigg\} = \lambda_z,\end{aligned} \tag{26}$$

where λ_z is the derivative of the multiplier λ with respect to z. First, note the less interesting case, where $\lambda > 0$ and $I(z) = C$, so $I'(z) = 0$ and $\lambda_z < 0$. This is another way of seeing that $F_1(C, b, x)$ is concave in C (i.e., the rate of increase of F_1 decreases with increasing values of C).

When $I(z) < C$ and $\lambda = 0$ we have $\lambda_z = 0$ and $I'(z) < 0$. The greater the amount of cash expected to be available at the period's end (i.e., z is high), the smaller the investment $I(z)$ and therefore the closer it is to the optimal investment in a nonliquidity constrained world, namely to $\bar{I}$. In this region the dividend increases with z as $D(z) = C - I(z)$. Also, it is straightforward to check that $F_1(C, b, x)$ also increases in x.

In summary, there are four distinct modes of optimal financing/investment behavior. When $C > \hat{I}$ and $z < \bar{I} - f(\hat{I}) - \hat{a}$ we have $I = \hat{I}$ and the firm invests B

$= (\bar{I} - f(\hat{I}) - z - \hat{a})/r$ in the liquid asset. If all of B is borrowed the dividend payment is $D = C - \hat{I}$. If investment in the liquid asset is made partially out of the firm's own funds, D is smaller. (Remember that $\hat{I}$ solves $f'(\hat{I}) = r$, $\bar{I}$ solves $f'(\bar{I}) = R$ and $z \equiv x - bR^2$. The constant $\hat{a}$ is given in proposition 2.)

When $C < \hat{I}$ and $z < \bar{I} - f(C) - \hat{a}$, the firm is still choosing to invest $B = (\bar{I} - f(C) - z - \hat{a})/r$ in the liquid asset. All of B is financed externally, as all the firm's own funds are invested in the risky project, $I = C$.

High values of z mean good news. The parameter z takes on sufficiently high values in the complementary cases to the preceding two, so there is no need to invest in the liquid asset and $B = 0$. The next and last two cases are distinguished by whether $I = C$ or not. The dividing line is the curve defined by $H(C, z) = 0$, where

$$H(C, z) = -1 + f'(C)\left\{\frac{1}{R}\int_{\tilde{y}+f(C)+z\geq\bar{I}} g(\tilde{y})\, d\tilde{y} + \frac{1}{R^2}\int_{\tilde{y}+f(C)+z\leq\bar{I}} f'(f(C)+\tilde{y}+z)g(\tilde{y})\, d\tilde{y}\right\}. \quad (27)$$

When $H(C, z) > 0$ the cash constraint is binding and $I = C$. In the other case, when $H(C, z) < 0$, the optimal investment is $I(z)$ which satisfies $H(I(z), z) = 0$. The difference $C - I(z)$ is positive and paid out as dividend. The four policy regions are depicted in figure 1.

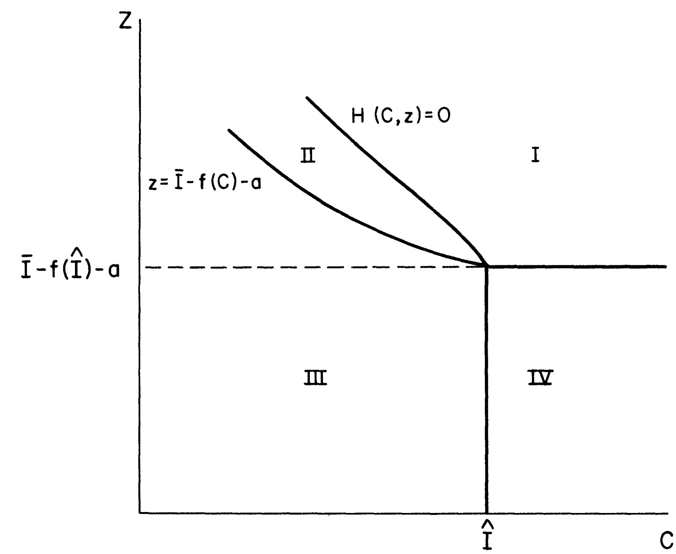

Figure 1. The four regions of investment/finance policies.

In region I, $D = C - I$, $b = 0$, $B = 0$ and $f'(I)Q(I) = 1$.
In region II, $D = 0$, $b = 0$, $B = 0$, $I = C$.
In region III, $D = 0$, $B = b = \frac{1}{r}(\bar{I} - f(I) - z - a) > 0$, $I = C$.
In region IV, $D = C - \hat{I}$, $B = b = \frac{1}{r}(\bar{I} - f(\hat{I}) - z - a) > 0$, $I = \hat{I}$.

IV. Discussion

The results are summarized in figure 1. For a fixed C, the higher z, the smaller the outside financing and the bigger is the distribution to security holders. Moreover, the higher z, the higher the firm's value F_1. To an empiricist who observes market values of firms and fund raising announcements this will be reflected as negative correlation between value and external financing.

An additional insight is that investment policy depends on anticipated cash flows. The opportunity cost of funds is lower when expected earnings are low, and hence the tendency to invest more in this situation. This conclusion emerges from the preceding section where the optimal investments in the two projects—the good project and the one which is purely for liquidity purpose—are positively correlated. It is noteworthy that investment need not mean an expansion or the pursuit of a new project. Funds to maintain the existing projects are also an investment.

Huart (1980) and Asquith and Mullins (1983b) look at the relation between stock prices and announcements of common stock flotation. Similarly, Dann and Mikkelson (1984) examine the relation between stock prices and announcements of convertible debt financing. Both studies find that the announcements are accompanied by significant downward price movements. Dann and Mikkelson (1984) also look at the effect of the announcement of straight bond financing. They report a slight, albeit insignificant, downward stock price movement. Dann (1981), Vermaelen (1981) and Masulis (1980) look at the opposite events, when firms announce stock repurchase plans. These announcements are found to be associated with upward price movements. The case of cash dividends is somewhat more problematic as this payout mode has tax implications. Miller and Scholes (1982) provide a critical assessment of the econometric problems associated with empirical studies of relations between stock returns and dividend policies. Our paper is about the relation between a change in dividend policy and the contemporaneous change in the equity price. The evidence here is clear, namely that stock prices are positively correlated with changes in dividend policy. Aharony and Swary (1980), Asquith and Mullins (1983a) and Brickley (1983) present such evidence. Kalay and Handjinicolaou (1984) provide evidence that stock prices increase (stock prices and bond prices decrease) when firms announce unexpected increases (decreases) in dividend payments.

Fama (see especially Section III of his 1974 paper) provides evidence that dividend policy does not help in explaining changes in capital outlays and vice versa. The change in net plant and equipment is Fama's proxy for investment. The view in the present paper is that investment is the money the firm spends in order to make money. Fama's proxy for investment hardly resembles this variable and therefore his evidence is not relevant to the present paper.

Watts (1973) and Gonedes (1978) construct time series models of earnings. They show that when trying to predict future earnings, current and past dividends provide little predictive power above current and past earnings. Their "earnings" are accounting earnings. In the present model we identify earnings with the firm's liquid assets. Therefore what we call "earnings" is different from their earnings, so the empirical findings of Watts and Gonedes should not be interpreted as evidence against our model. Furthermore, Watts (1973, section III.D) finds that "the sign of unexpected changes in dividends and the signs of the accompanying unexpected changes in future earnings are not independent." This conclusion supports the present model especially because it is based on a weak nonparametric test. Moreover, Kleidon (1982) regresses current changes in stock prices on future changes in dividends and finds the coefficient significantly positive. His time series are aggregate, rather than on a firm by firm basis. Kleidon finds a similar relation between stock prices and future earnings. More direct evidence about the relation between outside financing and earnings is provided by Vermaelen (1981) who reports that firms which repurchase their shares experience an increase in their earnings per share in the years following the repurchase.

Miller and Rock (1982) were first to note how widespread the negative relation between outside financing and stock prices was. To explain it, they set up the identity net cash flow = earnings − investment. Holding investment opportunities constant, Miller and Rock argue that net cash flow reveals earnings. Suppose, however, that the firm could always earn a market rate of return by holding treasury bills and that cash flow in and out of the firm incurs no transaction costs. Then the firm is indifferent about paying dividends and there is no reason that earnings and cash flow should be negatively correlated, except in extreme circumstances when the firm literally runs out of cash. In particular, Miller and Rock do not explain why the firm should ever distribute money to its security holders. Our emphasis is on the need for liquidity and the cost of liquidity. Consequently, we suggest a reason why cash flow and earnings are tightly and systematically correlated.

Another related recent theoretical work was written by Myers and Majluf (1982). They (much like Miller and Rock) explore issues of information asymmetries and their impact on investment/financing decisions. One of their interesting conclusions emphasizes the importance of financial "slack," that is, liquid assets. It affords investment in good (in the eyes of the well-informed management) projects without issuing new claims in the capital market. There are cases when the market is both poorly informed and skeptical about the firm's prospects. In these cases, the new claims would be underpriced to the extent that the new project would have negative present value to existing owners, and therefore would not be undertaken. Thus, financial slack is instrumental in overcoming Myers and Majluf "lemons" problem. The benefit from financial slack is clear in their work, but the cost is not, so the implied desired level of slack is infinity. Although information transmission is not of major concern to the firm in our model, financial slack is central in our model. One interpretation of Section III above is as a cost benefit analysis of financial slack.

REFERENCES

1. Joseph Aharony and Itzhak Swary. "Quarterly Dividend and Earnings Announcements and Stockholder Returns: An Empirical Analysis." *Journal of Finance.* 35 (March 1980), 1–12.
2. George A. Akerlof. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism." *Quarterly Journal of Economics.* 84 (August 1970), 488–500.

3. Paul Asquith and David Mullins, Jr. "The Impact of Initiating Dividend Payments on Shareholders' Wealth." *Journal of Business.* 56 (January 1983), 77–96.
4. ———. "Equity Issues and Stock Price Dilution." Working paper: Harvard Business School, 1983b.
5. Sudipto Bhattacharya and Jay R. Ritter. "Innovation and Communication: Signalling with Partial Disclosure." *The Review of Economic Studies.* 50 (April 1983), 331–346.
6. James Brickley. "Shareholder Wealth, Information Signaling and the Specially Designated Dividend—An Empirical Study." *Journal of Financial Economics.* 12 (August 1983), 187–209.
7. Robert W. Clower. "A Reconsideration of the Microfoundations of Monetary Theory." *Western Economic Journal.* 6 (December 1967), 1–8.
8. Larry Y. Dann. "Common Stock Repurchases: An Analysis of Returns to Bondholders and Stockholders." *Journal of Financial Economics.* 9 (June 1981), 113–138.
9. Larry Y. Dann and Wayne H. Mikkelson. "Debt Issuance and Capital Structure Change: Impact on Shareholder's Wealth." *Journal of Financial Economics.* To appear, 1984.
10. Eugene Fama. "The Empirical Relationship between the Dividend and Investment Decisions of Firms." *American Economic Review.* 64 (June 1974), 304–318.
11. G. Handjinicolaou and A. Kalay. "Wealth Redistributions or Changes in Firm Value: An Analysis of Returns to the Bondholders and to the Stockholders Around Dividend Announcements." *Journal of Financial Economics.* To appear, 1984.
12. Marie-Claire Huart. Analyse De L'Efficience Du Marche Boursier Americain Au Travers Des Augmentations De Capital Par Emission D'Actions. Institut d'Administration et de Gestion, Universite Catholique de Louvain: Belgium, 1980.
13. Allan Kleidon. "Stock Prices as Rational Forecasters of Future Cash Flows." Working paper: University of Chicago, 1982.
14. Ronald W. Masulis. "Stock Repurchase by Tender Offer: An Analysis of the Causes of Common Stock Price Changes." *Journal of Finance.* 35 (May 1980), 305–319.
15. Merton H. Miller and Franco Modigliani. "Dividend Policy, Growth and the Valuation of Shares." *Journal of Business.* 34 (October 1961), 411–433.
16. Merton H. Miller and Kevin Rock. "Dividend Policy under Asymmetric Information." Working paper: University of Chicago, 1982.
17. Merton H. Miller and Myron Scholes. "Dividends and Taxes: Some Empirical Evidence." *Journal of Political Economy.* 90 (December 1982), 1118–1141.
18. Stewart D. Myers and Nicholas J. Majluf. "Stock Issues and Investment Policy When Firms Have Information Investors Do Not Have." Working paper #1258-81: Massachusetts Institute of Technology, 1981.
19. Jack Shohet and Richard Rikert, eds. Accounting Trends and Techniques. New York: American Institute of CPAs, Inc., 1982.
20. Theo Vermaelen. "Common Stock Repurchases and Market Signalling: An Empirical Study." *Journal of Financial Economics.* 9 (June 1981), 113–138.
21. Ross Watts. "The Information Content of Dividends." *Journal of Business.* 46 (April 1973), 191–211.

DISCUSSION

ANDREW H. CHEN*: Abundant empirical evidence has shown a negative relation between a firm's external financing and its market value, though there does not appear to be a single, widely accepted explanation for this observation. Professor Huberman's paper represents an important addition to the existing theories that attempt to explain the empirical observation that external financing activities of firms are usually accompanied by a decrease in their equity values. The financial

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