NBER WORKING PAPER SERIES

SIGNALING AND ACCOUNTING INFORMATION

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Working Paper No. 3193

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1989

This paper is part of NBER's research program in Financial Markets and Monetary Economics. Any opinions expressed are those of the author not those of the National Bureau of Economic Research.

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ABSTRACT

This paper develops a signaling model in which accounting information improves real investment decisions. Pure cash flow reporting is shown to lead to underinvestment when managers have superior information but are acting in shareholders' interests. Accounting by prespecified, "objective" rules alleviates the underinvestment problem.

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1. Introduction

This paper develops a signaling model in which accounting information improves real investment decisions. Pure cash flow reporting is shown to lead to underinvestment when managers have superior information but are acting in shareholders' interests. Accounting by prespecified, "objective" rules alleviates the underinvestment problem.

The motivating ideas are as follows. Outside investors are assumed to observe the firm's revenues and net cash flow without error. But they do not know how to interpret cash <u>out</u>flows. If outflows are higher than expected, it could mean that cash expenditures for current activities are unexpectedly high (bad news), or that positive-NPV investment opportunities are unexpectedly expanded (good news). Absent other information, investors' reaction to higher-than-expected outflows will "average out" these two possibilities, and in most reasonable cases the bad news will dominate. Managers, who know the truth, will tend to underinvest in order to reduce cash outflow, report higher net cash flow, and support current stock price.

Accounting conventions help by partly distinguishing current from investment outflows. Thus expenditures for plant, equipment and other tangible assets are labeled as investment outflows, and put on the balance sheet; current income is supposed to equal revenue less current outflows only.

These conventions are only rules of thumb. If accounting were perfect, it would classify outflows as "good news" or "bad news," not by class of expenditure. Thus many good news, positive-NPV outlays never qualify for the balance sheet, for example when expanded opportunities lead to outlays for R&D, training and testing, start-up losses of new ventures or technologies, etc. Unfortunately, unexpectedly high outlays for R&D, training or start-up -- and even for capital equipment -- may reflect problems with current operations (bad news) rather than expanded investment opportunities. Outside investors do not know. Outside accountants do not know either.[1]

This paper does not attempt to present a general theory or survey of the "meaning of accounting." It presents a simple formal model in which (1) managers and investors are rationally concerned with reported book earnings, (2) firms underinvest in order to report lower costs and higher earnings, and (3) book earnings convey information not contained in reported cash flow. However, the paper does not rule out other explanations for these three points. For example, managers' and investors' attention to reported earnings may be triggered by links between managers' personal compensation and earnings, or by attempts by managers to protect their firms from adverse regulatory or political developments. Watts and Zimmerman (1986) review research on these and related lines of argument.[2]

This paper ignores agency, regulatory and political issues. It assumes that managers' and stockholders' objectives are aligned. Managers, acting in (a particular definition of) shareholders' interest, bond themselves to accept "objective" accounting procedures to relieve the underinvestment caused by signaling. So far I have found no prior research that anticipates this approach or result.[3]

This paper now turns to assumptions and notation, followed by a more careful discussion of the boundary between good-news and bad-news outflows. Then Section 4 shows the conditions under which firms will be tempted to underinvest in order to pretend to have more good news than they actually do. Section 5 presents the signaling equilibrium, and Section 6 shows how noisy but objective accountants can reduce underinvestment. Section 7 contains brief concluding comments.

2. Assumptions and Notation

The three main ingredients of the signaling models I have in mind are: (1) the inability of investors (or outside accountants or objective accounting rules) to distinguish good-news from bad-news outflows, (2) an objective function which responds to current stock price as well as intrinsic value, and (3) the resulting signaling-by-underinvestment problem and the potential use of accounting to alleviate it.

In the current period the firm reports:

$$\text{Cash flow} = R - X = R - C - I \tag{1}$$

where R = cash revenue

C = cash outflows for current operations

I = cash outflows for investment

$X \equiv C + I$ = total cash outflows

Although revenue and total cash outflows are separately observable by outside investors, current and investment outflows are not. Managers, on the other hand, know C as well as R. They accept R and C, but control I.

Managers' investment decision I reflects the investment opportunity schedule G(I), with $dG/dI \equiv G_I > 0$ at $I = 0$ and $d^2G/dI^2 \equiv G_{II} < 0$. Absent asymmetric information, the firm would invest to the point where $G_I = 0$. Since financing decisions will play no role, we can implicitly assume that investment is financed by cutting back cash dividends or, if necessary, by issuing shares.

The assumed objective function responds to current stock price P as well as intrinsic value V:

$$\max W = \alpha P + (1-\alpha)V, \tag{2}$$

where α is a fixed weight between 0 and 1.

This objective could be justified in several ways. For example, shareholders might vote for it ex ante if each saw a probability α of selling in the upcoming period, and also believed that intrinsic value is an unbiased predictor of the following period's price ($E(P_1) = V_0$). Whatever the justification, it's essential for signaling story that the objective function put partial weight on the current price P.[4]

Equilibrium requires that managers maximize this objective with respect to I, given current stock price P:

$$\max W = W(I \mid R,C,P(I)) \tag{3a}$$

Also, P must be an unbiased estimate of V given the limited information available to investors.

$$P = E(V \mid R,X) \tag{3b}$$

Intrinsic firm value V depends on net current cash flow, R - C, and on G(I). Investors and managers agree on the form of the function $V(R-C, G(I))$. Also, V is defined before any payout of current cash flow and before new shares, if any, are issued to finance investment.

3. Distinguishing Current and Investment Outflows

This paper's concept of current and investment outflows is not the same as the generally accepted accounting definitions of operating cost and capital investment. I start with a more primitive idea, the distinction between cash spent to support current production and other planned, business-as-usual activities and cash spent in pursuit of newly discovered opportunities.

First story. -- The dividing line between current and investment outflows depends on the nature of the firm's activities. Think of a firm entering a period with a fixed capital stock and a commitment to produce a well-defined basket of products or services. The out-of-pocket cash expenditures required for this production are not known ex ante, but managers observe them immediately after production starts. At the same time they learn about next period's demand and decide how much to spend to expand the capital stock. Investors then observe revenue and total cash flow and infer what they can about outlays for production and for investment.

This is one of several stories that could be attached to the algebra presented below. This story defines current and investment outflows in a more or less standard way. Moreover, we can safely assume that larger-than-expected outflows for present production are bad news and that larger-than-expected investment in next period's capital stock is good news (because it reveals larger future demand).

Second story. -- Here is a more complex story which captures more of this paper's motivation. Suppose the firm enters the current period with (1) a commitment to produce a basket of products or services and (2) a planned program of investment outlays for product development, training, replacement and modification of capital stock, etc. This program would include cash outlays prompted by investment opportunities identified in previous periods.

Shortly after the start of the period, the actual cash outlays required for categories (1) and (2) are revealed to managers, who also learn about any new investment opportunities. The managers then decide how much cash to invest in the new opportunities. They also can increase or reduce outlays in category (2).

We can now define current outflows to include the hands-off realizations in category (2) -- i.e., the actual cost of the business-as-usual investments planned at the start of the period:

Operating outflows = C = (1) production outflows plus (2A) actual cash outflow of planned investment

Investment outflows = I = (2B) cash flows from modifications of planned investment plus (3) investment for new opportunities

Obviously (2B) can be positive or negative. We will assume (3) is positive although there obviously could be new information prompting disinvestment.

Either of these stories will support the models developed below. The first is simpler and easier to connect to accounting practice. The second makes it easier to appreciate the real-life difficulties of interpreting unexpected cash outflows.

Larger-than-expected cash outflows are normally bad news in categories (1) and (2A) and good news in categories (2B) and (3). For example, suppose the firm is halfway through construction of a new manufacturing plant. If difficulties are encountered, and cash is flowing out unexpectedly fast, the bad news is reflected in (2A). On the other hand, it's usually good news if construction is on target but the firm decides to invest more to bring the plant on line faster. This cash outflow would fall in (2B).

The outside investor who observes the additional cash outflow usually does not know what it means. Whether it's good or bad news depends on the manager's motive for spending the money. Of course managers who worry about current stock price are always tempted to provide the upbeat interpretation of their actions, so a good-news press release does not resolve the matter.[5]

I believe that separation of good-news and bad-news cash outflows is, at least for mature firms, the single most difficult task for outside investors and security analysts. Most unexpected cash outflows have two competing interpretations. Does an increase in R & D outlays reflect new positive-NPV opportunities or cost overruns on existing projects? Do unexpected hiring and training costs mean increases in projected future demand or simply that existing workers aren't as productive as management had thought? Is purchase of a new machine motivated by the opportunity to make a new product or by the discovery that old machines can't cope with current demand for existing products? It's hard for an outsider to know.

4. The Incentive to Underinvest

The assumptions given so far are still too broad to support a specific signaling model. We can nevertheless explore the conditions necessary for the incentive to underinvest that will drive the model's behavior.

Suppose investors believe that the firm is investing optimally. Would its managers be willing to confirm those expectations, given an objective that weights current price P in addition to intrinsic value V?

It depends on the relative importance (and uncertainty) of current outflows versus investment opportunities. If investment opportunities are unimportant, and investors are concerned mostly with news about current operations, firms will be tempted to underinvest in order to pretend to have low current outflows and high profits. If uncertainty about investment opportunities is large enough, however, firms may be tempted to overinvest in order to pretend that growth opportunities are expanded.

The temptation to underinvest should dominate for established firms. The following analysis illustrates why. Assume the firm can only report revenue R and cash outflow $X \equiv I + C$. It provisionally decides to invest the optimal amount I*, consistent with investors' expectations. Now it considers changing I and X. Since $V_I = 0$ at I*, the change in the objective function is

$$W_I = \alpha P_I = \alpha P_X \tag{4}$$

Managers will reduce I from I* if $P_X < 0$.

Investors, who in this instance don't know they are about to be fooled, try to price at intrinsic value. Before X is announced,

$$P = E(V) = V(R) + \int_C \int_{I^*} [H(I^*) - M(C)]\, f(I^*)\, f(C)\, dI^* dC \tag{5}$$

Here $H(I^*)$ is outsiders' best estimate of NPV once they know that optimal investment is I^* (although ex ante they do not know what I^* will be). $V(R)$ and $M(C)$ are the capitalized values of revenue R and current cash outflow C.

For any given C, I^* is no longer a random variable; investors infer $I^* = X - C$. Therefore[6]

$$P(X) = V(R) + \int_0^X [H(X - C) - M(C)] \frac{f(C)}{F(X)} dC \qquad (6)$$

Managers then consider P_X, which resolves to:[7]

$$2P_X = -\frac{f(X)}{F(X)}\left[M(X) - E[M(C)]\left(1 - \frac{f(0)}{f(X)}\right)\right]$$

$$+ \frac{f(0)}{F(X)}\left[H(X) - E[H(I^*)]\left(1 - \frac{f(X)}{f(0)}\right)\right] - \left[E[M_C] - E[H_{I^*}] \right] \qquad (7)$$

The notation E[ ] is shorthand for investors' expectation over the range C = 0 to X. Note that $f(X)/F(X)$ and $f(0)/F(X)$ are the probabilities that C = X or 0 once X is observed.

Take the right-hand side terms in (7) one by one: an increase in X is (1) bad news[8] because it raises the upper bound on the capitalized value of possible costs, relative to the "average" M; (2) good news[9] because it raises the upper limit on investment and NPV, relative to the "average" H, and (3) bad news if, on average, an extra dollar of operating cost reduces value by more than an extra dollar of investment opportunities increases it.

Thus there are cases in which the firm is tempted to <u>increase</u> X, i.e. to overinvest. Suppose that there is little uncertainty about operating costs ($M(X) - E(M)$ small), great uncertainty about investment opportunities ($H(X) - E(H)$ large), and that this period's unanticipated operating costs are mostly viewed as transitory noise ($E[M_C]$ small). Then P_X could be positive.

But if the ranges of possible C's and I*'s are roughly the same,[10] underinvestment should win out, because the "M-terms" are likely to be much larger than the "H-terms".

All this falls out in a very simple way if the current outflow C is uniformly distributed over the range zero to X. In that case $f(0) = f(X)$ and $f(X)/F(X) = f(0)/F(X) = 1/X$. Suppose further that $M(C) = MC$, that is $M_C = M$, a constant. Equation (7) becomes

$$2P_X = -2M + \frac{H(X)}{X} + E(H_{I*})$$

If the "2M-term" is larger than the two corresponding "H-terms," P_X will be negative.

Suppose unanticipated current outflows and investment opportunities are transitory -- they do not affect expectations for later periods. Then $M(C) = C$ and $M_C = 1$, indicating a dollar-for-dollar reduction in V when C increases. Then P_X is negative unless $H(X)/X + E(H_{I*})$ exceeds 2.

These H-terms' units are basically NPV per dollar invested. If investment generates level, perpetual cash flow, H(X)/X is $\frac{IRR(X)-r}{r}$, where IRR(X) is the <u>average</u> IRR when $I^* = X$, and r is the cost of capital. For the other H-term,

$$E(H_{I*}) = E\left[\frac{IRR(I^*)-r}{r} + I^*\frac{dIRR/dI^*}{r}\right]$$

A positive P_X requires $\frac{IRR-r}{r}$ on the order of 1.0. For example, if IRR = 2r at all I*'s, then $\frac{IRR-r}{r}$ = 1.0 exactly, and $P_X = 0$. But finding a project that offers double the cost of capital in perpetuity is rare luck.

If changes in current outflows are expected to be permanent, then $M_C = \frac{1}{r}$, far in excess of reasonable NPV for an unanticipated dollar of investment.

The only ways to push P_X positive in these examples are to assume (1) unrealistically high profitability for unanticipated investment, or (2) that expanded investment today also signals expanded future opportunities, so that prospective NPVs are rolled into G(I) and H(I*). However, unrealistically high profitability may have to be assumed even in case 2. In order for present and future investments to be worth $\frac{1}{r}$ per dollar of current investment, the firm would have to earn twice the cost of capital in perpetuity on this year's project, and also gain the opportunity to invest in a perpetual stream of equally attractive projects. Only in such cases would $P_X \geq 0$ be plausible.

None of these comparisons prove that the underinvestment incentive will dominate. Highly profitable growth firms may be tempted to overinvest, in order to pretend to have better than their actual investment opportunities. However, the temptation to underinvest should dominate for mature firms. The next section takes a closer look at how this incentive plays out in a signaling equilibrium.

5. A One Period Signaling Model When Investment Opportunities Are Known[11]

This model guarantees an underinvestment incentive by assuming the investment opportunity function G(I) is known to investors. The model yields a fully-revealing signaling equilibrium formally similar to Miller and Rock's (1985), though with a different economic interpretation. In the end investors are not fooled by changes in reported cash outflow, but managers cannot escape underinvesting.

Assume there is some maximum possible current outflow $\bar{C}$. The investment function G(I) has a maximum G(I*) at I* > 0. Also G(0) = 0. We take M_C = M, a positive constant. Only cash flow is reported to investors.

In the fully-revealing equilibrium, outside investors infer the true value of C and I by observing X. From their point of view, C is a function C(X), I(X) = X - C(X), and P(X) equals the true value V:

$$\overbrace{P(X) = V(C(X),X)}\underbrace{\vphantom{P}= V(C,X)} \tag{8}$$

The top bracket shows investors' inference of V given X; the bottom bracket states that their inference is correct.

The firm maximizes W = αP + (1 - α)V, with V= V(R) + G(X - C) - M(C). It considers W_X:

$$W_X = \alpha(G_I(1-C_X) - MC_X) + (1 - \alpha)G_I \tag{9}$$

Note that the firm recognizes that a change in X will change P(X) by changing investors' beliefs about costs, C(X).

Set $W_X = 0$ and solve:

$$C_X = \frac{G_I}{\alpha M_C + \alpha G_I} \tag{10}$$

Figure 1 shows the equilibrium behavior of C(X) implied by this differential equation. Note that the firm does not underinvest when current cash outflow is at the upper bound $\bar{C}$. The firm makes the best of the worst possible case by investing I*. At that boundary ($C = \bar{C}$), $G_I = 0$ and $C_X = 0$.

But when $C < \bar{C}$, the firm underinvests to report lower X and to try to pretend that it is better than it really is. The result is shown in Figure 2. Note that dI/dX becomes very large as X approaches $\bar{X}$. The cost of underinvestment is low in this region because G_I is close to zero. Thus a firm with $C = .98\bar{C}$ has to underinvest "a lot" to distinguish itself credibly from the still-worse firm with $C = .99\bar{C}$. But when C is substantially less than $\bar{C}$, G_I and the cost of underinvestment are high, so less underinvestment occurs at the margin where C increases.

Figures 1 and 2 have been drawn so that lower X always signals lower costs and lower or equal investment. That requires $C_X \leq 1$ and $G_I \leq \frac{\alpha M_C}{1 - \alpha}$. Clearly this is so for I close to I*, because $G_I = 0$

at optimal investment. Reducing C and X drives I down and G_I up. As G_I approaches the lower bound $\frac{\alpha M_C}{1 - \alpha}$, I flattens out.[12]

The degree of underinvestment depends directly on α and on M. The incentive to signal is strongest when a heavy weight α is put on share price, rather than on intrinsic value, and when revealed current cash outflow has a large negative impact on market value. Note from (10) that higher α or M always reduce C_X for $X < \bar{X}$. Since $C(\bar{X})$ always equals $\bar{C} = \bar{X} - I^*$, a lower C_X requires a higher C(X) curve. Increasing α or M also increases the upper bound on G_I and reduces the minimum investment undertaken by low-cost firms.

Example. Suppose G(I) is a known, quadratic function of investment:

$$G(I) = 10I - I^2/2,$$

which implies $G_I = 10 - I$, $I^* = 10$ and $G(I^*) = 50$. The current outflow C is uniformly distributed over the range 0 to $\bar{C} = 10$, and $M(C) = MC$ ($M_C = M$, a constant). The present value of revenues is $V(R) = 200$.

If the firm does <u>not</u> underinvest, its ex ante value with M = 10 is

$$V = V(R) + G(I^*) - MC/2$$
$$= 200 + 50 - 10(10/2) = 200$$

Unfortunately, it will signal, and underinvest except when C is at the maximum $\bar{C} = 10$. Given C, the firm invests less when α and M are large. Figure 3 plots investment as a function of C for $\alpha = .3$ and M = 10. This behavior yields ex ante firm value of 194.7, a shortfall of 5.3 from the value of 200 assuming optimal investment. This shortfall is 10.5 percent of G(I*), the NPV of optimal investment. The mini-table below shows this shortfall for four combinations of α and M.

	$\alpha = .2$ M = 5	$\alpha = .3$ M = 5	$\alpha = .3$ M= 10	$\alpha = .5$ M = 10
Value lost	0.6	1.6	5.3	13.3
Value lost as percent of G(I*)	1.3	3.2	10.5	26.6

6. Gains From Nondiscretionary Accounting

The only possible role for accountants in the signaling model just presented would be to verify that cash revenues and outflows were honestly reported. They would not be required to *interpret* cash flows.

Real accountants do interpret, by putting some cash outflows on the balance sheet, leaving the residual as a "cost" of current operations. I regard this as a crude separation of good-news from bad-news outflows.

An accountant (or accounting rule) that could distinguish the true current outflow C embedded in X would eliminate signaling-by-underinvestment. (Once investors know C, $C_X = 0$, and setting $W_X = G_I = 0$ implies optimal investment.)

But an accountant cannot truly distinguish C from I because he or she must be an an outsider and thus can never be sure of insiders' motives for spending money. Indeed an accountant who attempted a subjective assessment of C and I would be naturally suspected of shading towards managers' and selling stockholders' interests. Instead, accountants (or accounting rules) classify expenditures not by their motivation, but by use, e.g. for wages, equipment, R&D, etc. This will convey valuable information, however, if expenditures that go on the balance sheet are more likely to be motivated by good news than expenditures that are left as current costs.

The imperfect accountant reports a "cost" estimate $\hat{C} = C + e$, where e is noise with expectation zero and range $\pm \bar{e}$. Assume that $\bar{e}$ is small enough that the upper end of this range, $\hat{C} + \bar{e}$, is less than $\bar{C}$ for at least some estimates C. The manager knows C when the investment decision is made, and $\hat{C}$ is independent of that decision. In other words, managers bond themselves ahead of time to accept the accountant's report $\hat{C}$.

This report is "objective" and not discretionary. The manager, who knows the true current outflow, and might instinctively like to report $\hat{C}$ as low as possible, cannot twist the accountant's arm or bend the accounting rules. As we will see, this commitment is in all shareholders' ex ante interests.

Consider a class of firms with a given reported $\hat{C}$ and actual current outflows ranging from $\hat{C} - \bar{e}$ to $\hat{C} + \bar{e}$. If they invest optimally, their true C's are revealed as C = X - I*. But since they face the same α's, G_I's and M's with or without the accountant on hand, they will again be drawn into signaling. The accounting report $\hat{C}$ defines a cohort with true current outflows ranging from $\hat{C} - \bar{e}$ to $\hat{C} + \bar{e}$. The worst firm in the cohort faces current outflows $\hat{C} + \bar{e}$. This worst firm has nothing to lose, invests I*, and reports X = C + I*. The rest underinvest.

Figures 4 shows the result. Given $\hat{C}$, the function $C(X \mid \hat{C}) = X - I^*$ when C is at its highest possible value $\hat{C} + \bar{e}$. As C declines, $C(X \mid \hat{C})$ slopes down to the left in the same general way as before.[13]

Clearly there is one $C(X \mid \hat{C})$ function for each possible $\hat{C}$,[14] all within the envelope of C(X) derived for a world without accountants.[15]

In other words, accountants reduce underinvestment. Figure 4 shows investment as a function of C given one possible value for $\hat{C}$. Again there is a family of such curves, one for each $\hat{C}$. All but one lie above the investments that would be made in a world without accountants. The one exception is the far-right curve, which begins with I^* at $\bar{C}$; this one lies on the envelope.[16]

The value of non-discretionary accounting is obvious. Firms underinvest less. All firms are worth more ex ante. Almost all firms are worth more ex post, and none are worth less. Table 1 shows how ex ante value lost from underinvestment depends on α, M and the accountant's maximum error $\bar{e}$. Naturally the loss decreases as the accountant's accuracy increases.

This table clearly illustrates why managers acting in shareholders' ex ante interests should bond themselves to accept the constraints of external, "objective" accounting rules.

A conjecture about conservatism. -- What kind of accounting signal does the manager hope for? For a signal $\hat{C}$ which is as low as possible; the firm is better off being a high-cost firm in a cohort with low reported costs. Thus in a one-period model, managers will always be tempted to cajole the accountant to understate costs and overstate reported income.

But if we pose the question differently the manager could vote for "conservatism" in accounting. Accountants define conservatism as a predisposition to record future losses and expenses, even when uncertain, but to defer recognition of revenues or other gains until proved. The idea is to provide the "most conservative measure of net income" and to "avoid unwarranted optimism."[17]

This could be rationalized as follows. Take the accounting signal $\hat{C}$ as given. What kinds of errors are most serious -- cost overestimates or underestimates?

Given $\hat{C}$, it's the underestimates that really hurt. The upper bound on true costs is critical. Look again at Figure 4. Given $\hat{C}$, a reduction in the maximum possible underestimate shifts the starting point of the upper curve, where $I(C \mid \hat{C}) = I^*$, to the left, and leads to higher investment for all firms with the same $\hat{C}$. Ex ante, the firm therefore prefers a "conservative" accountant; all firms in the cohort with the same $\hat{C}$ are better off if the maximum cost underestimate is as small as possible.

This kind of conservatism does not mean a low standard error. It means chopping off the right tail of the distribution of possible costs as close as possible to its mean -- not the same thing as fudging in an upward bias to $\hat{C}$. (Mere downward bias in cost estimates is pointless because investors will just take the fudge out again. Think of $\hat{C}$ as investors' expectation of costs given the accounting signal.) In this paper's analysis conservatism would mean changing the shape of the distribution. Accountants should shift their time and resources to the task of eliminating high-cost outliers.

7. Conclusions

The main points of the two models presented in this paper can be summarized as follows. The heart of the problem is asymmetric information, specifically investors' inability to distinguish cash outlays for current operations from outlays for investment. Managers are concerned with current stock price as well as intrinsic value, and thus are tempted to reduce investment in order to pretend to have lower operating costs. They end up in a signaling equilibrium in which investors learn the true operating costs of every firm. All but one firm must underinvest to maintain their place in the signaling equilibrium. The firm with the highest possible costs invests optimally, because there are not still higher-cost firms that could imitate it.

Signaling by underinvestment is a costly channel for information. Accounting reports are usually cheaper. If nondiscretionary accounting rules could identify true costs exactly, there would be no temptation to signal and no underinvestment. Noisy accounting cost estimates narrow the range of possible operating costs and reduce the scope for signaling. Investment is increased and the costs of signaling reduced.

The accounting cost estimates are not necessary to reveal true costs to investors. Signaling does that without any accounting reports. The noisy accounting estimates are a partial substitute for signaling; they convey information that would otherwise have to be signaled by underinvestment. Managers acting in shareholders' ex ante interests will bond themselves to report by "objective" rules implemented, or at least monitored by outside accountants.

This paper's analysis is formally similar to Miller and Rock's signaling treatment of dividend payouts. Their model also has the firm cutting back on cash outlays in order to initiate lower-cost and higher-income firms. However, they leave "income" undefined except by reference to economic theory. I have specifically identified the components of income which I believe to be at the heart of the problem, that is unanticipated cash outlays for current operations and investments.[18] Accounting information is valuable to investors primarily because it helps distinguish these two components, not because accountants attempt estimate true economic income.[19]

If I am right, some attempts to improve the accuracy or relevance of accounting income are just wasted motion. For example, investors' evident lack of interest in price-level adjusted accounts[20] is easily explained if investors are not looking to accounting information to estimate real economic income, but mainly to distinguish unanticipated current and investment outflows. Most of the information accountants provide on this distinction was already in historical cost books. For example, inflation adjusted income statements would restate depreciation in current dollars. Ideally, current replacement cost depreciation would be used. Obviously this would be a helpful step towards reporting real economic income. However, using a better depreciation number for past capital investment gives no assistance to investors trying to separate the good and bad news in unanticipated current cash outlays.

FOOTNOTES

* MIT Sloan School of Management and NBER. This paper's main ideas were developed during a visiting appointment at the London Business School. I thank Julian Franks, Paul Healy and Anthony Neuberger for helpful discussions. Research support from the MIT Sloan School of Management, MIT's Center for Energy Policy Research, and the London Business School is gratefully acknowledged.

1) Inside accountants, e.g. the controller, are treated as management.

2) Several recent papers present models which could explain accounting as a rational response to agency problems, in which a compensation rule or contract must be worked out in a situation where the manager's effort or performance cannot be observed directly. Examples are the papers by Lambert (1984) and by Demski, Patell and Wolfson (1984).

3) Titman and Trueman (1986) is a partial exception. They assume that firms want to signal low earnings volatility. Some firms can do this by damping fluctuations in reported income, but others cannot. Investors cannot distinguish the two groups. The result is a pooling equilibrium in which some high-volatility firms use income smoothing to imitate lower-volatility firms.

4) Miller and Rock (1985) discuss the pros and cons of this objective function. One obvious con is that putting no weight on current stock price ($a = 0$) leaves all shareholders better off ex ante. However, it's difficult to insulate managers from pressure from shareholders who have decided to sell right away.

Of course managers could pay attention to current stock price for other seasons, e.g. because of takeover threats.

5) See the discussion of "information costs" in Myers and Majluf (1984), 195-196.

6) If there is some known minimum value of C, we can net it against R and still integrate from zero to X in (6).

7) A derivation is available from the author.

8) Bad news unless the probability f(0) is much larger than f(X).

9) Good news unless f(X) is much larger than f(0).

10) In other words, I assume here for convenience that the ex post X is less than the highest possible ex ante I*.

11) Thanks to Anthony Neuberger for helpful comments on this model.

12) Could minimum investment be negative? Yes. If G_I is less than $\frac{\alpha M_C}{1-\alpha}$ when X - C = I = 0, firms with still lower costs will be forced to sell off assets (at a net loss) to signal effectively. Of course in such cases the zero point for investment could be redefined in terms of maximum disinvestment. For example I = $1 could reflect a decision to keep $1 of existing assets that could have been sold.

13) $C(X \mid \hat{C})$ is not an exact transposition of C(X) unless M_C is constant.

14) These functions "bunch up" when X is close to $\bar{X}$. Think of $\hat{C}_1$ and $\hat{C}_2$, with upper bounds $\hat{C}_1 + \bar{e} > \hat{C}_2 + \bar{e} > \bar{C}$. In each case the

worst possible firm has costs $\bar{C}$. Therefore the curves for $C(X \mid \hat{C}_1)$ and $C(X \mid \hat{C}_2)$ are identical.

15) We can show that the curves $C(X \mid \hat{C})$ never cross the $C(X)$ curve. For any cost $C < \bar{C}$, $C_X(X \mid \hat{C}) < C_X$ because the accounting signal leads to higher X and I and therefore lower G_I. $C_X(X \mid \hat{C})$ and C_X are equal in the limit of very low C. If the slopes are equal at this only possible crossing point, the curves cannot cross.

16) Note, however, that not all of this curve is likely to be populated. The best possible firm on this curve has costs $\bar{C} - 2\bar{e}$. Unless $\bar{e}$ is very large, there will be still better firms with lower C, which without accountants would have been on the envelope at lower investment.

17) See Davidson, *et al.* (1988), pp. 628-629, 725.

18) Remember that in my model cost and investment do not correspond to the accounting definitions of these terms. For example, I would define investment as cash outlays caused by unanticipated expansion of the investment opportunity set; anticipated capital outlays would be treated as a current "cost."

19) Book income does seem to convey information to investors that is not found just in reported cash flow. See, for example, Bowen, *et al.* (1987).

20) See, for example, Beaver (1983).

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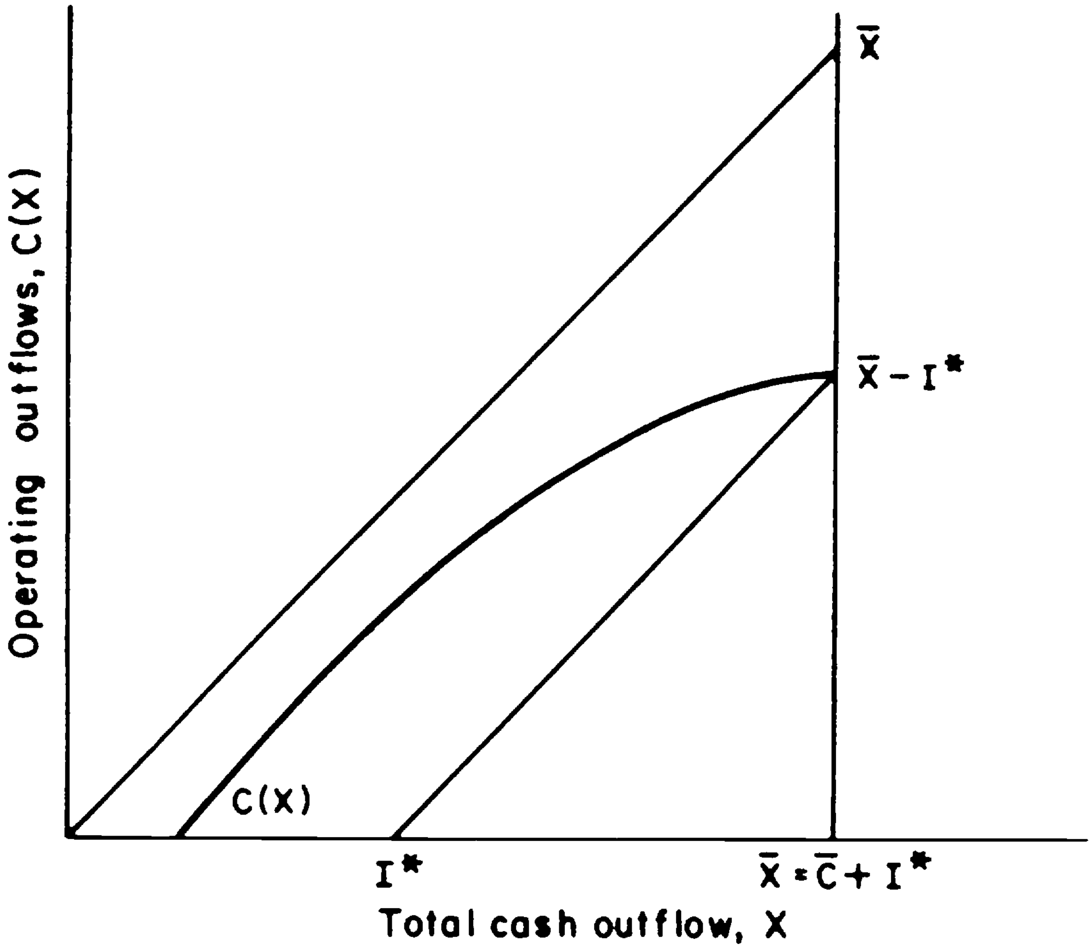


Figure I. Operating costs (C) as a function of total cash outflows (X) in a signaling equilibrim. C(X) is the heavy line.

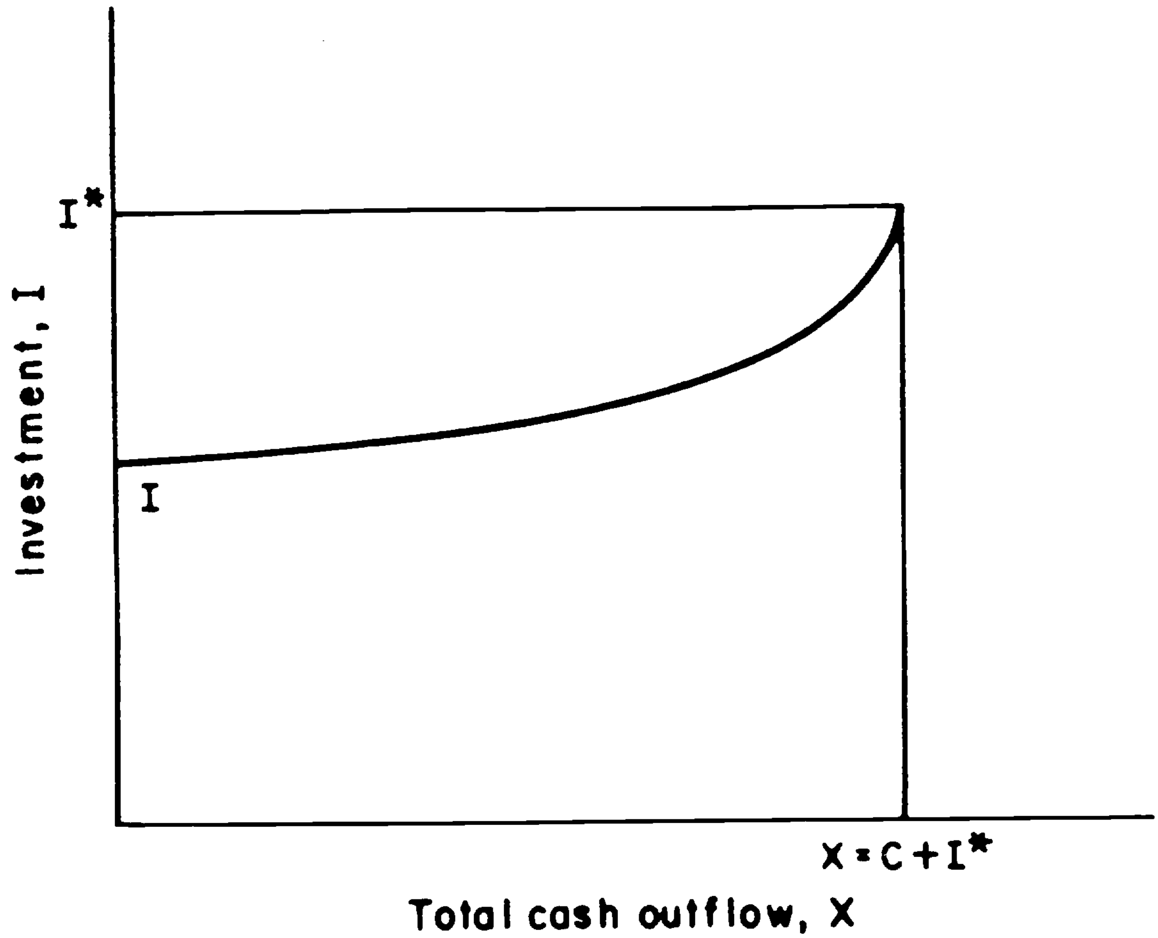
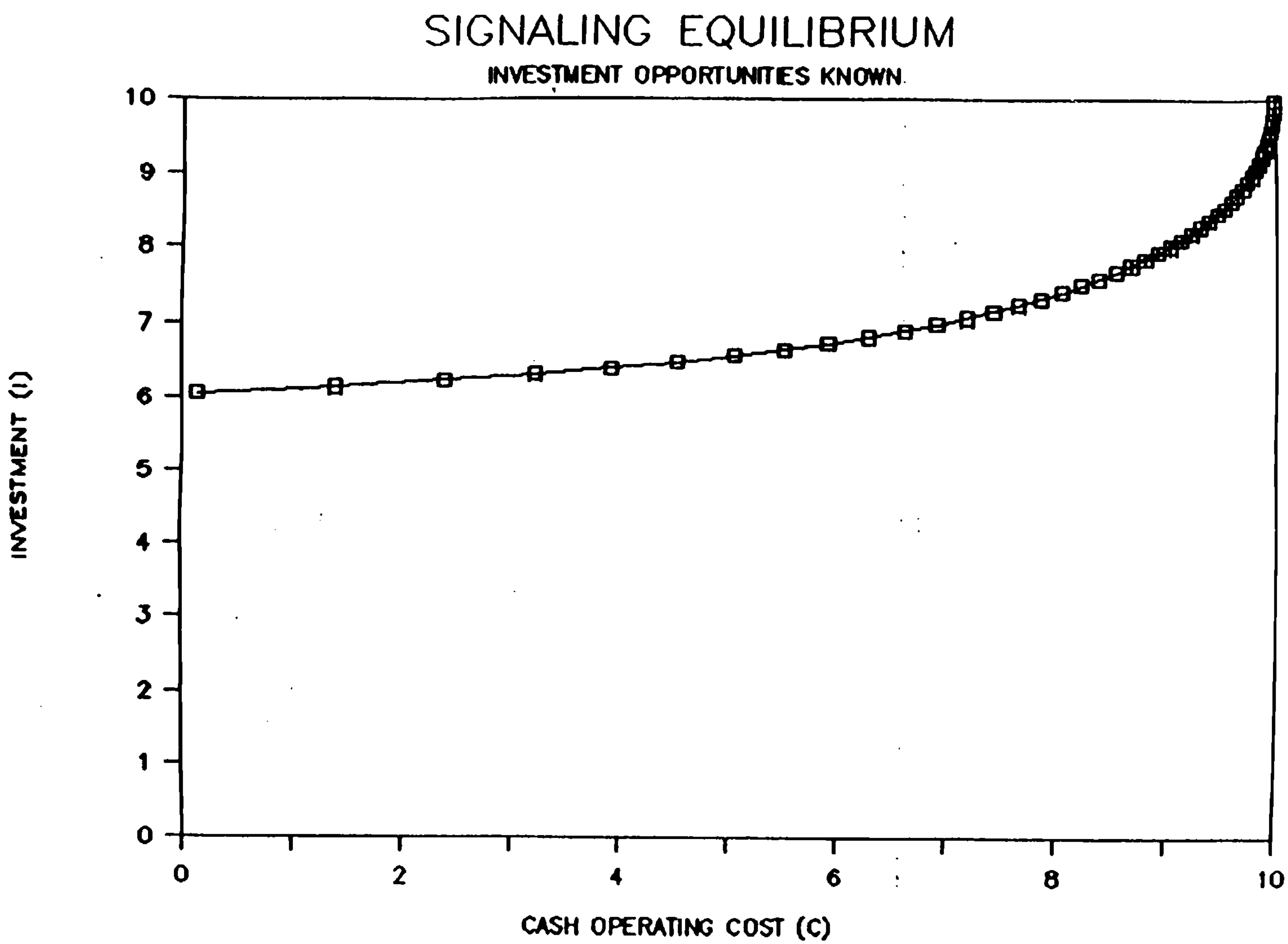


Figure 2. Investment as a function of total cash outflows X. The firm invests the optimal amount I^* only in the worst state where $C = \bar{C}$ and $X = \bar{X} = \bar{C} + I^*$.

FIGURE 3


SIGNALING EQUILIBRIUM
INVESTMENT OPPORTUNITIES KNOWN
INVESTMENT (I)
CASH OPERATING COST (C)
0
1
2
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4
5
6
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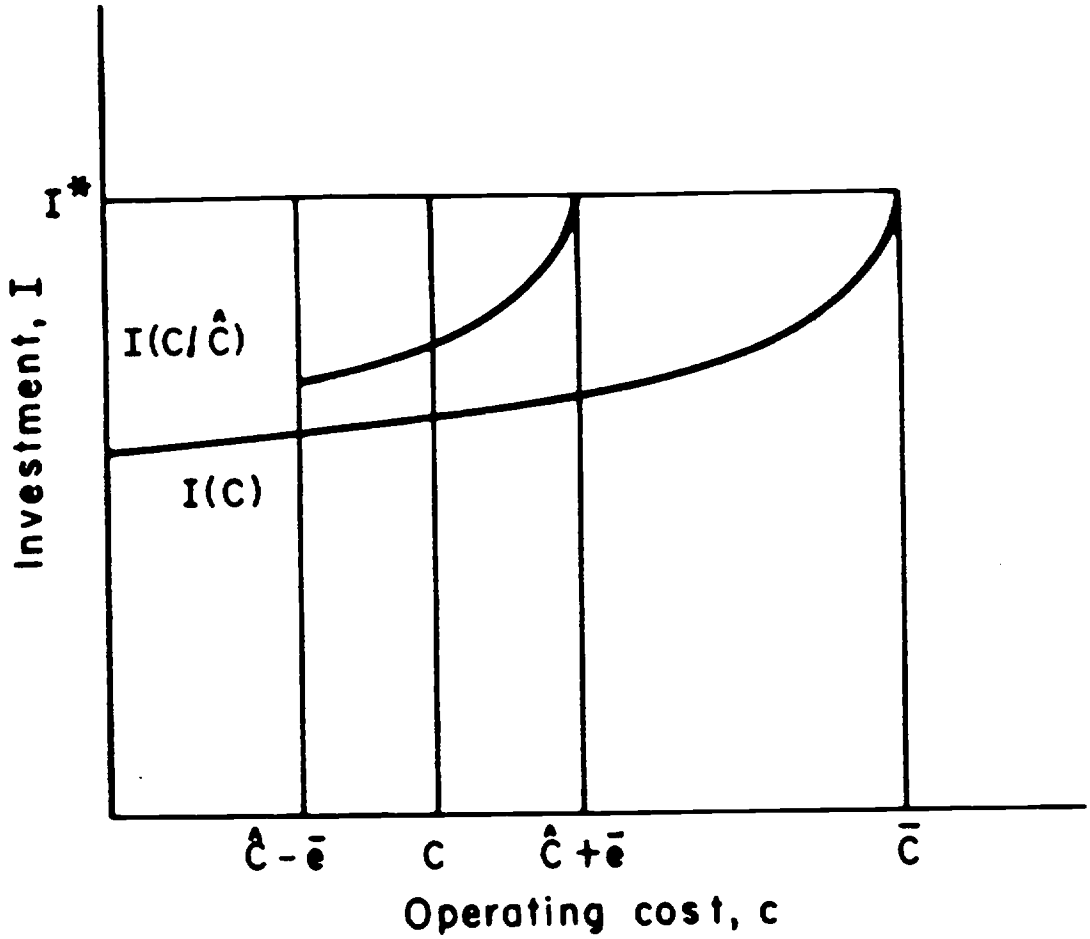

Figure 4. Investment as a function of operating cost c. The curve I(C/Ĉ) assumes accountants report a noisy cost estimate C. The film with the highest costs consistent with this estimate invests the optimal amount.

TABLE 1

Value Losses from Underinvestment with Noisy Accounting Signals (Percentage of NPV at Optimal Investment)

Accountant's Maximum Error, Percent of True Current Outflow	α = .2 M = 5	α = .3 M = 5	α = .3 M = 10	α = .5 M = 10
1	.15	.2	.5	.9
5	.5	1.0	2.2	4.2
10	.8	1.6	3.8	7.8
20	1.1	2.4	6.3	14.1
30	1.2	2.8	8.1	19.5
50	1.3	3.3	10.5	26.6
Value loss with no accounting signal	1.3	3.3	10.5	26.6