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The Issue Decision of Manager-Owners under Information Asymmetry

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ABSTRACT

A firm must issue common stock in order to undertake a new investment, and the firm's manager-owners can value the firm more accurately than the market. The ability of the manager-owners to trade in the firm's shares during the issue (a) reduces the investments that are foregone because of the market's mispricing the firm's shares, (b) changes the size and direction of the stock price change when the firm announces a new stock issue, and (c) changes the market value of the firm before and after the issue announcement, whether or not it decides to issue.

THE FOCUS OF THIS paper is a firm that must issue common stock in order to undertake a new investment. There is information asymmetry in the market for the firm's shares in that the firm's managers value its existing assets and the new investment more accurately than the market. Previous studies that investigated this setting include Myers and Majluf [11] and Leland and Pyle [7].

Myers and Majluf use a rational-expectations approach to (a) show the conditions under which the firms forego positive net-present-value (NPV) investments and (b) explain why firms' stock prices typically decline when they announce that new stock will be issued to finance new investment.¹ However, they assume that managers do not own or transact in the firm's shares. This paper extends their framework to consider the case in which managers are owners.

The issues examined here are (a) the extent to which the manager-owners' ability to trade in the firm's shares can reduce the foregone investments, (b) the impact of manager-owners upon the size and direction of the stock price change when the firm announces a new stock issue, and (c) the extent to which the purchases of new stock by manager-owners can signal the firm's value to the market. The latter subject was examined by Leland and Pyle.

Leland and Pyle examined the case of a new firm whose only resource was an asset in place, whereas this paper examines the investment and trading for the insiders of an existing firm. This firm has common stock outstanding and an existing asset and is considering issuing new stock and investing in another asset.²

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¹ See Smith [16] for a summary of these studies.

² Leland and Pyle model the insider's decision on the proportion of the firm to purchase, with the assumption that the insider has made the decision to issue. It involves equilibrium pricing using one

The model developed herein assumes that, if the firm decides to issue new shares, insiders can purchase or sell shares at the issue price during the issue. However, there are impediments (costs) to buying and selling the firm's shares, including loss of control when they sell, and wealth constraints and loss of diversification when they buy. Insiders will buy or sell the firm's shares if the capital gain from the trade is greater than the cost of the trade, and trading reaches equilibrium when insiders can no longer gain from an incremental transaction. In turn, the market uses the insiders' issue decision and trading during the issue to form a pooling equilibrium price for the firm's shares.

It is found that the insiders' ability to *sell* shares when the firm is overpriced does not change the states in which it issues, compared with the case in which insiders cannot trade in the firm's shares. However, the ability of insiders to *buy* shares when the firm is underpriced enables the firm to issue in more favorable states than when insiders cannot trade.

Second, since the firm will issue in more favorable states, the market value of the firm will be higher than when insiders cannot trade in the firm's shares both *before* and *after* the firm announces its issue decision, *whether or not the firm decides to issue*. Third, when insiders can trade in the firm's shares, the share price of a manager-owner firm may increase, decrease, or not change when the firm announces an issue of new shares. Myers and Majluf found that the share price of the non-manager-owner firm always declines when the firm announces a new equity issue.

Fourth, when insiders incur costs as they trade in the firm's shares, they may reduce their proportionate ownership of the firm during the issue, even when the firm is undervalued. Insiders will purchase less than the proportion they held before the issue, when the cost of additional purchases is greater than the gain of buying the firm's undervalued shares. This result is in contrast to the Leland-Pyle results, in which insiders always increase their proportionate ownership of undervalued firms.

These results also highlight that, in addition to the forfeiture of new investments and perk consumption, noninsider stockholders are susceptible to the agency cost of insiders issuing underpriced shares.³ That is, manager-owners can issue new stock when the new stock is underpriced because of asymmetric information, and, based upon their superior information, can insulate themselves from losses by purchasing a sufficient amount of the firm's shares during the issue. Old shareholders who do not purchase new shares can lose at the expense of new shareholders and insiders. However, this agency cost is different from

signal. The current model embodies two related signals: (a) issue-no issue and (b) proportion of the firm to hold. Thus, it is more akin to the decision framework of an existing firm's manager-owners.

³ Myers [10] has examined the forfeiture of a new investment when the required debt payment is greater than the investment's NPV. Similarly, John and Nachman [4] show that manager-owners will forego a new investment when the cash flow required for investment (which could otherwise be consumed as a perk by manager-owners) less the share of the investment's NPV going to other shareholders is greater than the investment's NPV. Jensen and Meckling [3] also model agency costs of equity. Their argument is related to that of John and Nachman, but the focus is not on underinvestment. Their manager-owners consume perquisites from the realized value of the firm, which is private information.

perk consumption and investment forfeiture since it occurs as the firm maximizes its value, i.e., as it accepts positive NPV investments.

This paper contains four sections. Section I describes the setting. Section II provides a numerical example of the model. Section III develops and discusses the model. Section IV is the conclusion.

I. The Setting

The market structure and other components of the setting are described by the following assumptions:

- (A1) The economy extends through three points in time: 0, 1, and 2.
- (A2) The uncertainty in the economy occurs uniquely at point 0. This uncertainty is described by a Radner-type state-preference model where insiders and the market do not know which state exists, but, given the state, the state payoffs are known with certainty.
- (A3) At time 1, the insiders' uncertainty is resolved, and only they know which state has occurred. The market has determined the probability of each of the m states⁴ that may exist: $P_1, \dots, P_m$. These m states are indexed by T , the total value of the firm, with state 1 having the lowest and state m the highest T .
- (A4) The firm makes its issue decision at time 1 after receiving the information about the true state.
- (A5) At time 2, the firm is liquidated and the true value of the firm is revealed to the market.
- (A6) Insiders own k of the firm's outstanding stock at time 1, before the issue decision is made, where $0 < k < 1$.
- (A7) Insiders can purchase or sell the firm's stock. However, there are restrictions on their transactions:
 - a. Trades may occur only at time 1, during the issue.
 - b. Insiders cannot reduce their proportion of ownership of the firm's shares to R , $R \geq 0$, or increase it to $R+$, $R+ \leq 1$.
 - c. The restriction just cited is enforced by a cost variable, S . S is a U-shaped function approaching infinity as the fraction of the firm's shares owned by insiders approaches R and $R+$. The loss of control is one of the costs assumed to restrict ownership to greater than R , and wealth constraints and the loss of diversification are costs assumed to restrict ownership to less than $R+$. The distribution of S is known by insiders and the market.
- (A8) There are no taxes, and markets are efficient with respect to publicly available information.
- (A9) The goal of the firm is to maximize the wealth of insiders.

⁴ There is a universe of, say, U states, within which is a subset of m states in which the investment has a non-negative net present value. The market knows that m is the relevant subset of possible states since insiders are considering this opportunity after receiving the additional information.

We start at $t = 1$ when an all-equity firm has received new information unavailable to the market. The firm has an asset in place with a true value of A . It must decide whether or not to issue I' in new equity to finance an investment with a net present value of B . If the firm does not invest in the opportunity at $t = 1$, B becomes negative. Both A and B are non-negative, and the market is aware of this. The following definitions hold at $t = 1$:

	True Values	Market Values	
		Issue	No Issue
Asset in Place	A	A'	$\underline{A}$
New Investment's NPV	B	B'	$\underline{\quad}$
Total Firm Value	T	T'	$\underline{A}$
New Equity	I	I'	$\underline{\quad}$

The total value of the firm if it issued, which is known only by insiders, is $T = A + B + I'$, whereas T' , the market's estimate of the firm's total value if it issued, is $T' = A' + B' + I'$.⁵ Thus, the market's error in estimating the present value of the new investment is encompassed in $B - B'$.

Assume the following issue process at $t = 1$. First, insiders decide whether the firm will issue. In making their decision, insiders assume that they will undertake the wealth-maximizing type (buy, sell, no trade) and dollar amount of trade in the firm's stock during the issue.

Second, the firm announces whether it will issue. The market price of the firm's shares adjusts to a pooling-equilibrium price given the firm's decision to issue new shares, and the firm issues I' in shares at that price. During the issue, insiders undertake the trade they assumed in their decision to issue.⁶ Third, the market then adjusts to the information provided by the manager-owners' trades (or lack thereof) during the issue and forms another pooling-equilibrium price for the firm's shares.

During the issue, insiders buy or sell rI' by undertaking n trades in discrete units of $r_u I'$, where $r_u > 0$ for purchases and $r_u < 0$ for sales.⁷ Thus $r = nr_u$, and $n = 0$ when insiders do not trade. Insiders stop at n trades when at trade $n + 1$:

$$r_u I' (T/T') - r_u I' - S_{n+1} \leq 0,$$

where S_{n+1} is the incremental cost (increase in S) incurred by insiders in making the $(n + 1)$ th trade. S is positive if $|r|$ is positive since insiders can incur costs in both buying and selling shares.

Given this framework, if the firm issues at $t = 1$, the wealth of insiders is

$$W = rI' (T/T' - 1) - S + kT(1 - I'/T'). \quad (1)$$

⁵ The present value of the investment opportunity is the sum of its net present value, B , and its cost, I' .

⁶ It is assumed that insiders can trade rI' anonymously. Ross [14, pp. 28, 30] has observed that insiders can gain from false signals if they are allowed to trade anonymously, thus precluding a signalling equilibrium. Gains from false signals can occur in this model only if insiders can buy/sell before liquidation at time 2. It is assumed that they cannot transact between time 1 and time 2, when true values are revealed to everyone.

⁷ Note that r_u and thus $r_u I'$ can be very small, but both are discrete.

If the firm does not issue, the wealth of insiders is

$$W = kA. \quad (2)$$

The goal of the firm is to maximize the wealth of the insiders. Thus, the firm will not issue if expression (2) is greater than expression (1), i.e. if

$$kA > rI'(T/T' - 1) - S + k(T - I'T/T'), \quad (3a)$$

or

$$A[(k - r)I'/T'] > (B + I')[k - (k - r)I'/T'] - rI' - S. \quad (3b)$$

In words, the firm will not issue and invest if the insiders' share of assets in place, A , going to new stockholders is greater than the insiders' share of the new investment's present value, $B + I'$, less the cost of the new stock.

Given that the true value of I' in new stock is I , where $I = I'(T/T')$, expression (3b) becomes

$$(k - r)(I - I') + S > kB. \quad (3c)$$

II. An Example

Given the setting, we provide a numerical example to show (a) the extent to which the manager-owners' ability to trade in the firm's shares can reduce the foregone investments, (b) the impact of manager-owners upon the size and direction of the stock price change when the firm announces a new stock issue, and (c) the extent to which the purchases of new stock by manager-owners can signal the firm's value to the market.

Assume that three possible states of nature exist for a firm that has an asset in place and an investment opportunity. At time 0, the market and insiders place probabilities of 0.7, 0.2, and 0.1 on the existence of states 1, 2, and 3, respectively. The cost of the investment, I' , is 200. The table below shows A , B , and T in each state:

	State 1	State 2	State 3
Asset in Place (A)	360	520	80
Investment Opportunity (B)	4	13	18
Total Firm (T)	564	733	1018

Note that the total value of the firm is $A + B + I'$. At time 1, insiders, who own half of the firm's stock, learn the true state and must decide whether to issue new stock and undertake the investment.

Consider first the case in which the cost of purchasing or selling new shares makes trading during the issue prohibitive. If the new investment is undertaken in every state because it always has a positive net present value, then T' , the expected value of the firm if it issued, is

$$T' = [0.7(564) + 0.2(733) + 0.1(1018)] = 643.2.$$

Suppose that state 1 is the true state and the firm issues. The wealth of insiders is

$$\begin{aligned} W &= rI'(T/T' - 1) + kT(1 - I'/T') - S \\ &= 0 + 0.5(564)[1 - 200/643.2] - 0 \\ &= 194.3. \end{aligned}$$

If the firm does not issue in state 1, the insiders' wealth is

$$\begin{aligned} W &= kA \\ &= .5(360) \\ &= 180. \end{aligned}$$

The wealth of insiders in each state for issue and no issue is shown below:

	State 1	State 2	State 3
W: Issue	194.3	252.5	350.7
W: No Issue	180.0	260.0	400.0

Given this decision matrix, insiders maximize wealth by issuing if state 1 occurs and by not issuing if states 2 or 3 occur. However, the market knows the payoff to insiders under each state. (They do not know the true state.) Thus, if the firm announces an issue, state 1 is signalled and T' becomes 564. The market value of the old shares before the issue decision is announced is

$$P_1(364) + P_2(520) + P_3(800) = 438.8.$$

In forming this estimate, the market knows that the firm will issue in state 1 and not in states 2 and 3. Suppose that state 1 occurs and the firm announces an issue. The value of the firm's old shares after the announcement of the issue decision becomes 364, and, if the firm announces no issue, the market value of the old shares becomes

$$\begin{aligned} [P_2(520) + P_3(800)]/(P_2 + P_3) &= [0.2(520) + 0.1(800)]/(0.2 + 0.1) \\ &= 613.3. \end{aligned}$$

Thus, the market values of the firm's old shares before and after the announcement of the issue decision are

Before Announcement	After Announcement		
	State 1	State 2	State 3
438.8	364 (Issue)	613.3 (No Issue)	613.3 (No Issue)

The market value of old shares declines from 438.8 to 364 when the firm announces an issue.

Now consider the case when insiders can trade in the firm's shares. Assume that, if the firm issues when T' is based upon issuing in every state, the cost function is such that insiders will purchase 80 of the 200 in new shares ($r = 0.4$)

when the firm is underpriced and sell 80 worth of the firm's shares ($r = -0.4$) when it is overpriced. Total trading cost incurred in both cases is 1. Recalculation of insiders' wealth when they can trade results in the following if the firm issues:

State 1:

$$\begin{aligned} W &= rI(T/T' - 1) + kT(1 - I'/T') - S \\ &= -0.4(200)[564/643.2 - 1] \\ &\quad + 0.5(564)[1 - 200/643.2] - 1 \\ &= 203.2. \end{aligned}$$

State 2:

$$\begin{aligned} W &= 0.4(200)[733/643.2 - 1] \\ &\quad + 0.5(733)[1 - 200/643.2] - 1 \\ &= 262.7. \end{aligned}$$

State 3:

$$W = 396.3.$$

Note that insiders sell 80 new shares in state 1 and purchase 80 in new shares in states 2 and 3 if the firm issues. The decision matrix becomes

	State 1	State 2	State 3
W: Issue	403.2	462.7	596.3
W: No Issue	380.0	460.0	600.0

Now the insiders will issue in states 1 and 2. However, the market is aware of this matrix, and a decision to issue signals state 1 or 2. Thus, if the firm announces an issue,

$$\begin{aligned} T' &= [0.7(564) + 0.2(733)]/(0.7 + 0.2) \\ &= 601.6. \end{aligned}$$

The market value of the old shares before the issue decision is announced is

$$0.7(364) + 0.2(533) + 0.1(800) = 441.4.$$

In forming its estimate, the market knows that the firm will now issue in states 1 and 2 and not in state 3. Likewise, when the firm announces an issue of new shares, the market value of old shares becomes 401.6.

Therefore, when insiders can trade, the market values of old shares before and after the announcement under each state are

Before Announcement	After Announcement		
	State 1	State 2	State 3
441.4	401.6 (Issue)	401.6 (Issue)	800.0 (No Issue)

In this case, the market value of shares falls from 441.4 to 401.6 when the firm announces an issue. Three things will be noted concerning the impact of the insiders' ability to purchase the firm's shares. First, the set of issue states was incremented by a more favorable (high- T) state. Second, the market value of the old shares is higher when insiders can trade than when they cannot, both before and after the issue announcement, in both the issue and no-issue outcomes.

Third, once the new shares have been issued, the market can use the signal provided by the insiders' trades and the firm's issue decision to value the firm more accurately. That is, if state 2 is the true state, insiders purchase 80 in new shares, and the market value of the firm shifts from 601.6 to 733. If state 1 occurs, insiders sell 80 in new shares and the market value of the firm shifts from 601.6 to 564. These adjustments occur only when insiders can trade in the firm's shares. Each of these results will now be generalized in the formal model.

III. The Model

The derivation of T' , the market value of the firm if it announced an issue, will be discussed first. Insiders make the issue decision based upon T' since it determines the price of the firm's shares, the payoff of trading during the issue, and ultimately the sign and size of insiders' gains from issuing. First, assume that the firm will issue in all of the m possible states. A trial estimate of the firm's value if it issued, T_{trial} , is derived:

$$T_{trial} = P_1 T_1 + \dots + P_m T_m.$$

Given the A and B in each state, each state is then tested to determine those in which⁸

$$AI'(k - r)/T_{trial} \leq (B + I')[k - (k - r)I'/T_{trial} - rI' - S]. \quad (4)$$

Suppose that expression (4) holds for x_1 states. If $x_1 < m$, then T_{trial} is not the equilibrium T' . Another T_{trial} is calculated with the x_1 issue states, and each of those x_1 states is evaluated to determine those in which expression (4) holds. If there are x_2 states in this category, T_{trial} is recalculated using the x_2 states, and each of those are tested, and so on. T_{trial} is recalculated with a smaller set of states until expression (4) holds for all of the states used to calculate T_{trial} . This final T_{trial} is T' , and x represents the number of states used to calculate T' .⁹ Thus, T and x are specified simultaneously. Both T' and x are known by the insiders and the market since they are calculated from information known by both.

Another important element of the model is the cost function, S . S is assumed to be zero when insiders issue and do not trade. This simplification is not very costly since most of the conclusions reached below hold when S is nonzero for the issue-no-trade case. (See footnote 15, second paragraph.) In addition, S is increasing in $|r|$ over the relevant range. We assume that the fraction of ownership never reaches R or $R+$, past which S may be constant.

⁸ The r used in this calculation is optimal for that state, given T/T' and S .

⁹ In the example of the previous section, the first T_{trial} is 643. The equilibrium T_{trial} ($=T'$) when insiders cannot and can trade in the firm's shares is 564 and 601.6, respectively.

A. Market Value Change upon Issue Announcement

What is the impact on the market value of the firm's outstanding equity when the firm issues new stock and insiders own stock? This question can be answered by first expressing the market value of the firm's outstanding shares before the issue announcement, M_b :

$$M_b = P(T' - I') + (1 - P)\underline{A}, \quad (5)$$

where P , the probability of the firm's issuing, is the sum of the probabilities in the x issue states. M_b is a rational-expectations estimate that embodies the expected value of the firm if it issued and if it did not issue. The market value of the firm's old shares after an announcement to issue, M_a , is

$$M_a = T' - I'. \quad (6)$$

M_a is a rational-expectations estimate of the value of old shares given the firm's decision to issue new shares. The change in the market value of the firm's stock when the issue is announced is the difference between expressions (5) and (6):

$$M_b - M_a = (1 - P)[\underline{A} - (T' - I')]. \quad (7)$$

Thus, the market value of the firm's old equity increases if $T' - I' > \underline{A}$, decreases if $T' - I' < \underline{A}$, and does not change if $T' - I' = \underline{A}$. We start with the basic model in which $r = 0$ for all issue states. This condition obtains when, for all states, the cost of trading always prohibits the purchase or sale of stock by insiders.¹⁰

PROPOSITION 1: *When the firm announces an issue of new shares and $r = 0$ in all issue states, the market value of the firm's outstanding shares will decline.*

Proof: When $r = 0$, expression (3b) reduces to

$$A > (1 + B/I')(T' - I'). \quad (8)$$

This relationship holds for every no-issue state. Since $B \geq 0$ (the investment has a non-negative net present value), $A > T' - I'$ in every state in which the firm does not issue. Given that $\underline{A}$ is the rational-expectations estimate of A for those states in which the firm does not issue, $\underline{A}$ must be greater than $T' - I'$, and, from expression (7), the market value of the firm falls when an issue is announced and $r = 0$.¹¹ Q.E.D.

Now consider the case in which r is nonzero in at least one issue state. As mentioned above, insiders buy or sell the firm's shares during the issue as long

¹⁰ For all issue states, the following conditions hold:

$$r_u I' (T/T') - r_u I' - S_1 \leq 0.$$

We assume that, in order to induce insiders to purchase, the impact of the trade on wealth must be positive.

¹¹ Expression (8) is equivalent to expression (1) in Myers-Majluf [11, p. 200], which refers to the issue-invest decision for the firm in which managers are not owners and current shareholders purchase none of the new shares. (Also note their expressions on pp. 198-99.) Thus, the decline in share price when insiders cannot purchase is equal to the corresponding decline in share price when managers and owners are separate.

as the capital gain on the sale or purchase is greater than the cost of the sale/purchase.

PROPOSITION 2: *The ability of the insiders to sell shares ($r < 0$) does not change the set of states in which the firm issues from the set existing when $r = 0$.*

Proof: Insiders sell shares when $T < T'$ and the capital gains from selling are more than the cost of selling. It is clear from expression (3c) that, when $r = 0$ in all states, the firm issues in all states in which $T \leq T'$ ($I \leq I'$ in expression (3c)). Thus, the ability of insiders to sell shares on personal account during the issue does not change the states in which the firm issues from those existing for the $r = 0$ case. Q.E.D.

PROPOSITION 3: *The ability of insiders to buy shares during the issue ($r > 0$) can increase the set of issue states from that prevailing when $r = 0$, and the increase will be in the higher valued (higher T) states.*

Proof: Consider a trial estimate of T' that assumes that the firm will issue in all of the m states. Select an arbitrary state j that, when $r = 0$, has the highest total firm value of any of the issue states. Consider T and A for state $j + 1$. If the firm issues in state $j + 1$ and $r = 0$, then the wealth of insiders is

$$kT(1 - I'/T'), \quad (9)$$

which is less than kA in state $j + 1$ by definition. If insiders can purchase, their wealth after an issue is

$$kT(1 - I'/T') + rI'(T/T' - 1) - S, \quad (10)$$

which must be greater than expression (9) since $rI'(T/T' - 1) - S$ must be positive. (Otherwise, insiders would not purchase.) If, for state $j + 1$, expression 10 is less than kA , the firm will still not issue, although insiders would purchase if the firm issued. When expression (10) is greater than kA , the firm will issue in a state in which it would not issue if purchasing were prohibitive. Thus, the ability to purchase can increase the number of issue states, and the increase is in higher valued (higher T) states. Q.E.D.

However, given rational expectations, the market will adjust the market value of the firm's old shares to consider that additional states will become issue states when insiders can purchase shares. Of course, no adjustments occur when insiders can purchase, but the set of issue states does not change from the set existing when $r = 0$. Consider the case when insiders can purchase shares "with effect", i.e., such that the firm will issue in at least one more state than when $r = 0$ in all issue states.

PROPOSITION 4: *The ability of insiders to purchase shares with effect during the issue increases the market value of the firm's outstanding shares (a) before the firm announces its issue decision and (b) after the firm announces its decision, whether or not the firm decides to issue.*

Proof: M_b is the market value of the firm's old shares before the issue decision is announced, and it is described in expression (5). Assume that, because insiders

can purchase shares during the issue, the highest ranking issue state is increased from x to $x + 1$. M_b increases by $P_{x+1}(T_{x+1} - I') - P_{x+1}A_{x+1} = P_{x+1}B_{x+1} > 0$. Thus, when insiders can purchase shares such that the issue states increase, the market value of the old shares is higher even before the issue decision is announced.

M_a , described in expression (6), is the market value of the firm's old shares after the decision to issue is announced. The change in M_a from insiders' purchasing with effect is embodied in the change in T' . T' increases when insiders can purchase with effect, based upon Proposition 3. T' will contain at least one higher value and no lower value T_j when insiders can purchase with effect. The general expression for the increase in T' when insiders can purchase with effect is derived in Subsection A of the Appendix.

$\underline{A}$ is the market value of the firm's old shares if it does not issue:

$$\underline{A} = (P_{x+1}A_{x+1} + \dots + P_m A_m)/(P_{x+1} + \dots + P_m), \quad (11)$$

where x is the highest value state in which the firm issues. When the highest value issue state increases from state x to state $x + 1$ because insiders can purchase with effect, the no-issue states decrease by state $x + 1$, but state $x + 1$ is at the low-value end of the no-issue set. Thus, $\underline{A}$ for no purchase (or purchase without effect) contains at least one lower value A and no higher value A than the $\underline{A}$ for purchase with effect. The result is that $\underline{A}$ increases when the insiders can purchase with effect. Subsection B of the Appendix derives the general expression for the change in $\underline{A}$ when insiders can purchase with effect. Q.E.D.

We have concluded that, even before the issue decision is announced and whether or not the firm announces an issue, the market value of the firm when insiders can purchase with effect is higher than when insiders cannot purchase. A related issue is the change in the market value of the firm's shares when insiders can purchase with effect and the firm announces an issue of new shares. The change in the market value of the firm's old shares upon the announcement of the issue, $M_b - M_a$, is derived in expression (7). Relating expression (7) to expression (3b) when r is positive, A could fall between $T' - I'$ and $B + Q(S - kB)$, where $Q = T'/I'(k - r)$, and then be less than $T' - I'$ when the firm issues and insiders trade.¹² Thus, $\underline{A}$, the market's rational-expectations estimate of A if the firm does not issue, may be less than, equal to, or greater than $T' - I'$. Unlike the results of the Myers-Majluf model, the market value of the firm's old shares may increase, not change, or decrease when the firm announces an issue and insiders can trade in the firm's shares.¹³

¹² Expression (3) may also be specified as $A > T' - I' - [B + Q(S - kB)]$.

¹³ This result may be compared with the Leland-Pyle analysis, which concludes that a lower proportion of the firm held by insiders implies a lower true value of the firm and that the market value of the firm should decline to reflect true value. In this model, the firm issues if (see expression (3c)):

$$(k - r)(I - I') + S \leq kB.$$

It is clear that the firm may issue when r is less than k and I is greater than I' . Thus, the proportion of the firm held by insiders may *decline* even when the firm is undervalued ($I - I'$). Thus, in this

Another related issue is the difference between the purchase-with-effect and no-purchase cases in the *change* in the market value of the firm's old shares when it announces an issue of new equity. Suppose that, for the purchase-with-effect case, there is an increase or no change in the market value of the firm's shares when it announces an issue. Here, the ability of insiders to purchase with effect results in a more favorable performance than when $r = 0$.¹⁴ However, even when insiders can purchase with effect, the share price may decline upon an issue announcement.

B. Market Value Change upon Completion of the Issue

When the new shares have been issued and the market learns of the insiders' trades, the market value of the firm shifts from T' to $\hat{T}$. This shift is a reaction to the information provided by the insiders' trades during the issue. Given rational expectations, $\hat{T}$, the market value of the firm after the issue, is

$$\hat{T} = (P_L T_L + \dots + P_H T_H) / (P_L + \dots + P_H), \quad (12)$$

where, if insiders bought shares during the issue ($r_u > 0$),

$$H = \text{the highest } T \text{ such that } T \leq T' [1 + S_{n+1}/r_u I'], \quad (13a)$$

$$L = \text{the lowest } T \text{ such that } T > T' [1 + S_n/r_u I'], \quad (13b)$$

if insiders sold shares during the issue ($r_u < 0$),

$$H = \text{the highest } T \text{ such that } T < T' [1 + S_n/r_u I'], \quad (14a)$$

$$L = \text{the lowest } T \text{ such that } T \geq T' [1 + S_{n+1}/r_u I'], \quad (14b)$$

and, if insiders made no trades during the issue,

$$H = \text{the highest } T \text{ such that } T \leq T' [1 + S_1/r_u I'], \quad (15a)$$

$$L = \text{the lowest } T \text{ such that } T \geq T' [1 + S_1/r_u I'], \quad (15b)$$

where $r_u > 0$ in (15a) and $r_u < 0$ in (15b). These adjustments reflect unbiased rational expectations in that they properly consider all available information provided by (a) the distribution of possible states (thus firm values), (b) the insiders' cost function for buying/selling the firm's shares, (c) the fact that the firm issues, and (d) the insiders' trading during the issue. In addition, when insiders trade the firm's shares during the issue, the resulting market-value adjustments (expressions (13) and (14)) leave insiders with no excess demand for trading in the firm's shares. When insiders do not trade during the issue, expression (15) may result in excess demand for trades. No excess demand for trading exists when insiders do not trade if (a) the market value of the firm does not change ($T' = \hat{T}$), (b) the market value of the firm moves closer to T , or (c)

model, a decrease in the proportion of insiders' ownership of the firm's shares—which would imply a decrease in firm value in the Leland-Pyle model—does not imply that the market value of the firm should decrease.

¹⁴ Remember that, if insiders cannot purchase with effect, the price of the firm's shares always declines when it announces an issue of new shares.

the market value of the firm moves in the wrong direction but not enough to make trading profitable.¹⁵

Although the market efficiently uses the available information to price the firm's shares, the trades of insiders create only a pooling equilibrium instead of a fully revealing signalling equilibrium. That is, the insiders' trades may not fully reveal the correct T . This may be a desirable trait of the current model in that it may be too much to expect signalling to remove all of the uncertainty about the value of the firm.¹⁶

IV. Conclusion

This paper has examined the issue-invest decision of a manager-owner firm. As Myers and Majluf have shown for the case in which managers are not owners, the price of the firm's shares declines when it announces an issue of new shares to finance new investment, and current shareholders will purchase none of the new issue. It has been shown here that the same decline in price occurs when the firm announces an issue and either (a) insiders cannot trade shares during the issue or (b) insiders' trades do not change the states in which the firm issues. When insiders can purchase shares during the issue such that the firm will issue in more favorable states, the market price of the firm's shares may increase, decrease, or not change when the firm announces an issue.

Three hypotheses concerning empirical relationships follow from the analyses above. First, for firms announcing new share issues, the proportion of manager-

¹⁵ Suppose the market value of the firm changes during the issue as insiders trade in the firm's shares. Assume that insiders can transact in some amount, say $r_u I'$, before the market adjusts and that insiders conduct n transactions. The wealth of insiders if the firm issues is

$$W = (1 - r)I' + rI'T/T_v + kT[1 - I'/T_w] - S,$$

where r is the net proportion of the new shares owned by insiders from their trades, T_v is the average market value of the firm when insiders made trades, T_w is the average value of the firm when the I' in stock was sold, and S is the total cost of the trades during the issue. Insiders can falsely signal to manipulate T_v and T_w in order to maximize their wealth. For example, by buying when shares are overvalued, there is a positive impact on insiders' wealth through an increase in T_w and a decrease in the fraction of the firm held by new shares. This gain may offset the capital loss on the shares purchased and the cost of the trade. One possible solution to this moral-hazard problem is for the market to minimize its adjustments to trades by insiders during the issue. The basic model is obtained when these adjustments approach zero.

Suppose that the cost of the issue when insiders do not trade, S_0 , is nonzero. In order to maintain a cost function that is U-shaped in the fraction of ownership of insiders, the following relationships would hold: when $S > 0$, $dS > 0$ for all sales, and $dS < 0$ for initial purchases, with dS becoming positive and approaching infinity as the fraction of ownership approaches $R+$; when $S_0 < 0$, $dS > 0$ for all purchases, and $dS < 0$ for initial sales, with dS becoming positive and approaching infinity as the fraction of ownership approaches R . Expressions (13) and (14) still hold, but (a) when $S_0 > 0$, S_n and S_{n+1} in expression (13) may be positive or negative, and (b) when $S < 0$, S_n and S_{n+1} in expression (14) may be positive or negative. The result is that, with a nonzero S_0 , it becomes possible for the adjustment from T' to $\hat{T}$ to leave insiders with excess demand for additional trades when they have traded in the firm's shares during the issue.

¹⁶ On this point, see Ross [13, p. 413]. The inability of insiders' trades to signal exact value is due to the discrete nature of the model rather than an absence of the conditions specified for a signalling equilibrium as discussed by Riley [12] and Spence [17].

owner firms with non-negative share-price changes is positive and greater than that for firms in which managers are not owners. Second, for firms announcing new share issues, the proportion of preissue to postissue share-price declines (increases) for firms in which insiders sell shares will be higher (lower) than those for firms in which insiders buy shares during the issue. Third, for firms announcing new share issues, the insiders' trades during the issue is a better predictor of the change in share price than the proportion of shares held by insiders. That is, increases and decreases in share price are more related to purchases and sales of shares than increases and decreases in the proportion of the firm held by insiders.

With regard to the first hypothesis, empirical studies have found that the share prices of firms typically decline when they announce issues of new shares to finance new investment. However, not all firms' share prices decline. A statistical test of the ratio of negative and non-negative share-price changes indicates that each of the studies contains a statistically significant proportion of non-negative share-price changes.¹⁷ Although this shows that some firms' share prices do not decline, further evidence is needed on the insider ownership and trading to verify the first hypothesis. Evidence on the second hypothesis is provided by Masulis and Kowar [8]. For their sample of industrial firms, they find that share prices of firms with insiders who sold stock during the issue fell more than the share prices of the firms with insiders who were not reported to have sold stock during the issue.¹⁸ The third hypothesis has not been tested.

Although previous empirical studies are not inconsistent with the results of the model derived here, further empirical tests are required. There are difficulties in clearly analyzing the impact of insiders' trades when firms announce new security issues, in that adjustments must be made for the lack of information regarding the trades of insiders and the trading arrangement of insiders when the firm issues new equity.

Appendix: The Impact of Trading with Effect

Let T^* and T' represent the market value of the firm if it announces an issue and insiders can and cannot trade with effect during the issue, respectively. Similarly, let A^* and A represent the market value of the firm if it announces no issue and insiders can and cannot trade with effect during the issue, respectively. Finally, let x^* and x be the number of states in which the firm will issue if insiders can and cannot trade with effect, respectively.

¹⁷ Binomial tests were conducted by the author to determine whether the proportion of non-negative share-price changes found in each study was statistically significant. The studies analyzed are Asquith and Mullins [1], Kolodny and Suhler [6], Masulis and Kowar [8], Mikkelsen and Partch [9], and Schipper and Smith [15]. For example, given that Asquith and Mullins found that twenty percent of the 121 firms in their study experienced non-negative share-price changes when a new equity issue was announced, we can reject the null hypothesis $H_0: R = 0.16$ for the alternate hypothesis $H_1: R > 0.16$ at the five percent level, where R is the true proportion of non-negative share-price changes. See Hollander and Wolfe [2, pp. 15–18].

¹⁸ Karpoff and Lee [5] find that insiders trade both before and after the announcement to issue new stock. However, they do not measure the impact of the trades on the market value of traded firms' shares.

A. Proof That $T^* > T'$

$$\begin{aligned}
T^* - T' &= \sum_i^* P_j T_j / (\sum_i^* P_j) - \sum_i P_j T_j / (\sum_i P_j) \\
&= \sum_i P_j T_j / (\sum_i^* P_j T_j) + \sum_{x+1}^* P_j T_j / (\sum_i^* P_j) \\
&\quad - \sum_i P_j T_j / (\sum_i P_j) \\
&= Y_1 \sum_{x+1}^* P_j T_j / (\sum_{x+1}^* P_j) - Y_1 \sum_i P_j T_j / (\sum_i P_j), \quad (A1)
\end{aligned}$$

where $Y_1 = (\sum_{x+1}^* P_j) / (\sum_i^* P_j)$. Since states are indexed by T_j , the true value of the firm if it issued in state j , all of the T_j 's in the positive summation term in (A1) are greater than those in the negative summation term. Thus, the positive term must be greater in absolute size than the negative term, and $T^* > T'$.

B. Proof that $A^* > A$

$$\begin{aligned}
A^* - A &= \sum_{x+1}^m P_j A_j / (\sum_{x+1}^m P_j) - \sum_{x+1}^m P_j A_j / (\sum_{x+1}^m P_j) \\
&= \sum_{x+1}^m P_j A_j / (\sum_{x+1}^m P_j) - \sum_{x+1}^m P_j A_j / (\sum_{x+1}^m P_j) \\
&\quad - \sum_{x+1}^* P_j A_j / (\sum_{x+1}^m P_j) \\
&= Y_2 \sum_{x+1}^m P_j A_j / (\sum_{x+1}^m P_j) - Y_2 \sum_{x+1}^* P_j A_j / (\sum_{x+1}^* P_j), \quad (A2)
\end{aligned}$$

where $Y_2 = (\sum_{x+1}^* P_j) / (\sum_{x+1}^m P_j)$. A_j , the value of the asset in place in state j , is also indexed by size. Thus, all of the A_j 's in the positive summation term in (A2) are larger than the A_j 's in the negative term. As a result, the positive term in (A2) is greater in absolute terms than the negative term, and $A^* > A$.

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