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Insider Trading around Dividend Announcements: Theory and Evidence

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ABSTRACT

The informational role of strategic insider trading around corporate dividend announcements is studied based on the *efficient equilibrium* in a signalling model with endogenous insider trading. Insider trading immediately prior to the announcement of dividend initiations has significant explanatory power. For firms with insider selling prior to the dividend initiation announcement, the excess returns are negative and *significantly lower* than for the remaining firms (with no insider trading or just insider buying) as implied by our model. Another implication is that dividend increases may elicit a positive or *negative* stock price response depending on the firm's investment opportunities.

THERE IS CONSIDERABLE EMPIRICAL evidence on stock price reaction to the announcement of dividend changes.[1] Since the documented evidence suggests that these announcements convey to the market some private information possessed by corporate insiders, signalling models have been used to explain the price reaction. Although recent signalling models have shed some light on important aspects of the announcement effect of dividends, many questions remain. Why should dividend increases be treated always as good news by the market? How do the investment opportunities available to the firm affect the market response to dividend changes?[2] Since insiders often have material private information prior to announcements of major dividend changes (e.g., initiation of dividends), how would their own trading activity

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[1] Dividend announcement effects appear in Pettit (1972), Charest (1978), Aharony and Swary (1980), Asquith and Mullins (1983), and other papers too numerous to cite. Bhattacharya (1979), John and Williams (1985), Miller and Rock (1985), Ambarish, John, and Williams (1987), and others provide explanations of these announcement effects based on signalling models.

[2] It has been suggested that the information content of dividend changes should be related to the investment opportunities available to the firm, see Graham and Dodd (1934), Woolridge and Ghosh (1985), and Lang and Litzenberger (1989).

reflect this?[3] How would disclosures of this trading (say, through filings with the Securities and Exchange Commission) (SEC) and consequent market inferences affect the information content of the dividend announcements?

A partial answer to these questions appears in this paper in which we study the informational role of strategic insider trading around corporate dividend announcements. We take the perspective that their own trading activity (subject to disclosure regulation) is one of the most direct signals available to insiders to convey private information to the market. In other words, insider trading is an alternative signal which may compete with dividends as a signal. If this is true the information content of dividend announcements cannot be fully understood without examining concurrent insider trading activity. Here we investigate the issue theoretically and empirically.

The framework we use to study possible interaction of insider trading and dividend announcements is that of a signalling equilibrium where *potentially* both activities are allowed to be used as signals. Since either signal can, by itself, convey private information to the market, an additional requirement is imposed on the signalling equilibrium—that it be *efficient*. In the *efficient* signalling equilibrium the choice of signals (either one or the other exclusively or an optimal mix of the two signals) minimizes signalling costs. Characterization of the equilibrium strategies and the resulting market pricing function form the basis of several interesting implications.

First, it is shown that the optimal choice of signals always involves a blend of the two signals—in other words, both dividends and insider trading are used at nonzero levels in equilibrium. This implies that an interaction of the two signals is the *norm* rather than the exception. Implications for insider trading around dividend announcements are derived from equilibrium strategies of the insiders and the market pricing function in the *efficient* signalling equilibrium. Here the nature of the firm's technology (its investment opportunity set) determines the interaction of the signals in equilibrium. The model yields a number of empirical implications. Some of them relate the direction and intensity of the stock price response to (i) the direction and magnitude of dividend change, (ii) the direction and magnitude of insider trading activity, and (iii) the nature of firm technology.

The model of this paper is related to John and Mishra (1990) where it is argued that given the disclosure rules regarding trading activity of corporate insiders, the extent of insider trading should be considered an important component of the mix of signals used by a firm. However, they do not

[3] Over the last 20 years a number of studies of insider trading have focused on the abnormal returns earned by corporate insiders on their stock transactions. A common claim documented in these studies is that outsiders can also earn abnormal returns by using the publicly available information concerning insider trades that appears in the Securities and Exchange Commission's (SEC) monthly publication, *Official Summary of Security Transactions and Holdings* (Official Summary). See, e.g, Lorie and Niederhoffer (1968), Pratt and DeVere (1968), Jaffe (1974a, 1974b), Finnerty (1976a, 1976b), Givoly and Palmon (1985), Seyhun (1988a, 1988b), and Rozeff and Zaman (1988). Choi (1986), Karpoff and Lee (1987), and Copeland and Lee (1988) examine aspects of insider trading around corporate announcements.

examine corporate dividends nor undertake empirical tests of the model. The model of this paper can also be understood as an amalgamation of extended versions of two important models, namely Leland and Pyle (1977) and Miller and Rock (1985). Our cost structure of insider holdings is similar to Leland and Pyle (1977), but their model does not allow for endogenous investments, differential investment opportunity sets, or dividend signalling. Our cost of dividend signalling is driven by suboptimal investments in equilibrium as in Miller and Rock (1985), but our model differs in many important ways from theirs. Firstly, by endogenizing insider trading in the information equilibrium we are able to characterize its effect on concurrent dividend announcement. Secondly, by modelling the quality of the investment opportunity set as the private information of insiders (as opposed to current earnings used by Miller and Rock (1985)) we are able to relate the announcement effect of dividend changes to firm technology. In particular, we demonstrate that the positive announcement effect of increases in dividends obtained in the Miller and Rock model holds true only for a subset of technologies. For another subset of technologies the announcement effect of increases in dividends will be to *decrease* stock prices. This prediction of the *efficient signalling equilibrium* of this paper is unique and is in sharp contrast to that of earlier dividend signalling models.

One of the novel predictions of this model is that dividend increases *cannot* always be taken to signal *good news*. To interpret the signal properly one has to examine the concurrent insider trading activity. Unexpected dividend increases, accompanied by unusual insider buying, signals good news and should elicit a positive stock price response. Dividend increases accompanied by no unusual insider trading should cause *no* price change. However, dividend increases accompanied by unusual insider selling signal bad news and should elicit a *negative* stock price response.

An empirical test of the model based on announcement effects of dividend initiations and insider trading activity prior to the announcement is presented. Some interesting empirical issues crop up in going from the theoretical model to the empirical setting. For example, the direct output of the model presented is a cross-sectional pricing function relating stock prices and equilibrium choices of dividends and insider trading. In the empirical context, insiders trade prior to the dividend announcement, i.e., the signals are revealed to the market sequentially rather than simultaneously. This issue is addressed in formulating the empirical tests in the paper. In a way this should help in formulating testable hypotheses from information models in general.

Using data on dividend initiations we test the main predictions of our model. Earlier studies (e.g,. Asquith and Mullins (1983)) document a positive announcement effect of dividend initiations. Here we stratify the sample based on insider trading activity within a specified time, say a quarter prior to the announcement day. The announcement day excess return for the group of firms with either insider buying or no insider trading is significantly higher than that for the insider selling group. Moreover, the excess return for the intense selling subgroup is -0.5% vis a vis $+2.2\%$ for the intense buying group. The evidence, by and large, is consistent with the predictions of the equilibrium of this paper. In particular, the evidence suggests that rather than viewing insider trading and dividend changes as additive independent signals, the market views them as complementary signals. More specifically, our evidence suggests that on the day of initiation announcement, the market uses its information about insider trading to interpret properly the informational content of dividend increases. On the other hand, we show that the evidence cannot be explained based on any of the prior signalling models.

The rest of the paper is organized as follows. The basic model is presented in Section I. The signalling equilibrium with multiple signals and the pricing function are characterized in Section II; some of the formal details are relegated to the Appendix. The announcement effects are derived and empirical implications discussed in Section III. The empirical evidence is presented in Section IV. Conclusions and extensions are sketched in Section V.

I. The Model

The model captures the essential aspects of insider trading around dividend announcements in a simple tractable framework. In their strategic interaction with a less informed market, corporate insiders consider the information content of changes in dividends and revisions in insider holdings.

First, the basic structure of the model is laid out. Then we discuss the relationship of the model here to the models of Leland and Pyle (1977), Miller and Rock (1985), and John and Mishra (1990). Exploiting an isomorphic relationship between the algebraic structure of the John and Mishra model and the model here simplifies the specification of the equilibrium and derivation of its properties.

At $t = 0$, the beginning of our single period, the firm has current cash C, which includes the cash from operations as well as any external financing done at firm level selling riskless claims.[4] The firm has access to an investment opportunity set referred to as its technology and denoted as $f(I, \theta)$. The technology represents a set of assets such that an investment of amount I made at $t = 0$ results in a random cash flow $f(I, \theta) + \tilde{u}$ at $t = 1$ for a firm of quality θ (specified in detail below), where $\tilde{u}$ is a normally distributed random variable with mean zero and variance σ^2. Consider a corporate insider (an entrepreneur) who chooses at $t = 0$ to hold a fraction α of the firm and to sell the residual fraction $(1 - \alpha)$ to outsiders in the market. He also decides and announces a dividend payout D and invests I, where I is the residual amount $C - D$, in the technology of the firm.

The parameter θ, $\theta \in \Theta = [\theta_l, \theta_h]$ $\theta_h > \theta_l > 0$, which indexes the quality of firm technology is assumed to be private information; it is known to the

[4] The outside claims the firm can issue for external financing are restricted to be riskless debt and equity. This assumption is made primarily for tractability of the model. For convenience, we include the riskless claims in C and treat separately the outside equity sold. Such an assumption is common to papers in this area, see Miller and Rock (1985), John and Williams (1985), Ambarish, John, and Williams (1987), and John and Mishra (1990).

corporate insiders but not observed directly by outsiders. In particular, insiders observe the private attribute θ before choosing their holdings α and the dividend payout D, whereas outsiders must attempt to infer θ from the observable actions of insiders. Except for θ, all other parameters of the subsequent problem are common knowledge, including those of the prior distribution π of θ and the distribution of $\tilde{u}$. For example, the current cash C is fully revealed to outsiders through costless corporate audits. Similarly, corporate audits will verify that $I = C - D$ is the level of investment actually undertaken. The cash flows are realized at the end of the period and distributed pro rata to the shareholders.

Higher θ represents more favorable private information. In other words, for all feasible I, i.e., $I \geq 0$ and all $\theta \in \Theta$, we have $f(I, \theta_2) > f(I, \theta_1)$ when $\theta_2 > \theta_1$. Also the function $f(\cdot, \theta)$ is positive, continuously differentiable, strictly increasing, and strictly concave in investment, with the corner conditions $f'(0, \theta) = \infty$ for all $\theta \in \Theta$.

The entrepreneur-insider is risk averse and has a negative exponential utility function with coefficient of absolute risk aversion h, $h \geq 0$. He invests the portion of his wealth not tied up in the firm in a riskless asset (assumed to have a zero rate of return). We also assume that risk-neutral valuation is appropriate for the economy.[5]

The corporate insider maximizes his expected utility of the end-of-period wealth $\tilde{W}$, given his private information θ. This is a function of the market price paid for the fraction of the firm sold. This market price, however, can only depend on common knowledge and the observable actions of the insiders. In other words, the pricing function used by the market will be a function of D and α (and parameters of all common knowledge). Let $P(D, \alpha)$ be the cum-dividend price assigned by the market for the entire firm value. The optimization of the corporate insider can be specified as follows: choose the insider holding α and the dividend payout D to maximize his expected utility, conditional on the pricing function P. This optimization is *equivalent* to:[6]

$$\mathrm{Max}_{\alpha, D \geq 0}\, \alpha\left[D + f(C - D, \theta)\right] + (1 - \alpha) P - \frac{h}{2} \sigma^2 \alpha^2. \tag{1}$$

Let $\{\alpha(\theta), D(\theta)\}$ denote the solution to (1).

Use $V(\theta, \alpha, D)$ to denote the value which the market would have assigned to the entire firm (cum-dividend) had it been informed of the value of θ.

[5] The valuation rule assumed is not critical for our results. An alternative specification of the economy with risk-averse investors and a CAPM valuation rule produces similar results for α, (see Leland and Pyle (1977)).

[6] For h and σ^2 large enough, it can be shown that any solution to optimization (1) automatically satisfies $\alpha \leq 1$. For expositional ease, we will not carry this constraint along. Arguing in the spirit of Leland and Pyle (1977), where suboptimal diversification provides the signalling costs of α, clearly any value of α close to its value in a well-diversified portfolio would satisfy the constraint $\alpha \leq 1$.

Given risk-neutral pricing by the market,

$$V(\theta, \alpha, D) = D + f(C - D, \theta). \tag{2}$$

Now the specification of an *efficient* signalling equilibrium (with multiple signals) is standard (see John and Mishra (1990)). Corporate insiders select their optimal holdings $\alpha(\theta)$ and the firm's optimal dividends $D(\theta)$ to satisfy the incentive-compatibility condition (1), given a pricing function P, corporate cash C, and information θ. In turn, outsiders buy new shares (and trade outstanding shares), believing correctly that the stock's total market price, measured cum-dividend, equals its concurrent true value:

$$P[\alpha(\theta), D(\theta)] = V[\theta, \alpha(\theta), D(\theta)] \tag{3}$$

Among all combinations $\{\alpha(\theta), D(\theta), P[\alpha(\theta), D(\theta)]\}$, the *efficient* signalling equilibrium solves the following problem:

$$\text{Max}_{P \geq 0} \int_{\theta} U\{\theta, \alpha(\theta), D(\theta), P[\alpha(\theta), D(\theta)]\} \, \mathrm{d}\pi(\theta), \tag{4}$$

subject to criteria (1) and (3), where $U(\theta, \alpha, D, P)$ is the maximand in (1). In other words, among all feasible signalling equilibria, defined by (1) and (3), the pricing function P must minimize ex ante signalling costs. A signalling equilibrium $\{\alpha(\theta), D(\theta), P[\alpha(\theta), D(\theta)]\}$ which satisfies (1), (3), and (4) will be called the *efficient* signalling equilibrium.[7]

The intuition behind the efficient signalling equilibrium here is appealing. Insider trading, by itself, can convey changes in insider information credibly. Similarly, changes in dividends alone can signal all changes in private information. However, using both signals strategically achieves signalling most efficiently, i.e., the optimal mix of the two signals minimizes signalling cost. Moreover, the strategic interaction of insider trading and dividend announcements and its effect on concurrent stock price response provide a rich harvest of empirically testable implications.

The Leland and Pyle (1977) model is a special case of the model here. In that model, the signalled value is not a function of endogenous investment and dividend is not allowed to be a signal. However the signalling cost of insider holdings is common to both models. Our model is similar to Miller and Rock (1985) in that dividends are residual to investments and suboptimal investments drive the signalling costs of dividends. But there are some crucial differences. While the fraction of insiders selling is exogenously specified in Miller and Rock (1985), we endogenize the direction and magnitude of insider trading in our model. Insider trading is shown to interact with dividend choices and affect in important ways the announcement effect of dividend changes. In the Miller and Rock model, current earnings is the

[7] See Spence (1973), Riley (1979), and Cho and Kreps (1987) for a discussion of signalling games and equilibria. For other papers which study an efficient signalling equilibrium with multiple signals, see Ambarish, John, and Williams (1987), Milgrom and Roberts (1986), and John and Mishra (1990). Vishwanathan (1987) also examines equilibria with multiple signals.

attribute of private information, and it does not directly affect the investment opportunity set. In our model the private information indexes the quality of the investment opportunity set. In fact, the interaction of the quality parameter with the productivity of investment determines whether the equilibrium strategies will involve underinvestment or overinvestment. It will also determine whether the market should interpret an increase in dividend as good news or bad news. In the Miller and Rock model, as well as all other dividend signalling models, increases in dividends always connote good news.

Our model is closely related to John and Mishra (1990): changes in capital expenditures is the corporate announcement instead of changes in dividends. For a given value of corporate cash C, since $D = C - I$, for the range of values $D \geq 0$ and $I \geq 0$, the equilibrium strategies in John and Mishra (1990) have a direct counterpart to those in our model. However the isomorphism is not complete for the cases when $D + I > C$. Whereas in John and Mishra (1990) they allowed possibly negative dividends to ensure $I \geq 0$, here we constrain $D \geq 0$, $I \geq 0$ and allow the firm to sell more outside claims affecting α in equilibrium. In cases where the details of the steps in the derivation of the equilibrium can be constructed from those in John and Mishra (1990), we do not present them here.

It should be noted that although the models are close in terms of their algebraic structure, there is no simple correspondence between the signals per se as discussed above. Moreover, the model here yields many implications which are important in the context of the extensive literature on announcement effect of dividends. In fact, our focus is on the interpretation of the results in the context of the dividend literature and formulation of testable hypotheses.

II. Equilibrium and Its Properties

We characterize the efficient signalling equilibrium and its properties in this section. These include the optimal insider holdings and dividend announcements in equilibrium as well as the market pricing function and its properties. These properties and the implied announcement effects will be shown to be crucially dependent on the investment opportunities available to the firm. In fact, the intuitive notion that a firm which increases dividends because it has no good investment opportunities may be conveying negative information is appealing. To formalize it in our signalling equilibrium we subdivide investment opportunity sets into three classes based on how the marginal product of current investment I varies with θ, the private information attribute. For ease of reference, we call these three classes of firms, MP+ firms, MP0 firms, and MP− firms.

Definition 1: A firm, $\theta \in \Theta$ will be called an MP+ firm if $\dfrac{\partial^2 f}{\partial I \, \partial \theta} > 0$, an MP0 firm if $\dfrac{\partial^2 f}{\partial I \, \partial \theta} = 0$, an MP− firm if $\dfrac{\partial^2 f}{\partial I \, \partial \theta} < 0$, for all θ and all $I \geq 0$.

The marginal product of current investment is increasing in θ among MP+ firms for all $I \geq 0$, whereas among MP0 firms it is constant and among MP− firms it is decreasing. Similarly the Pareto-optimal investment I^o (such that $\partial f(I^o, \theta)/\partial I = 1$) is increasing in θ among MP+ firms, constant in θ among MP0 firms, and decreasing in θ among MP− firms. This latter characterization suggests that MP+ firms may be loosely identified with those in growth industries (higher quality firms optimally need larger investment outlays) and MP− firms with those in mature or declining industries (higher quality firms do *not* require larger investment outlays).

Now we proceed to characterize the efficient signalling equilibrium for the different classes of firms. To accomplish this we follow John and Mishra (1990).

Proposition 1: *The insider holding and dividend strategies in the efficient signalling equilibrium can be characterized as follows*: (*i*) *For all but the poorest firms insider holdings are higher than required for optimal diversification.* (*ii*) *Equilibrium levels of dividends are increasing in θ among MP− firms, decreasing in θ among MP+ firms, and constant in θ among MP0 firms.* (*iii*) *Among MP+ firms, all but the poorest firms overinvest. Among MP− firms, all but the poorest firms underinvest. Among MP0 firms investment is at full-information optimal levels.*

Proof: See Appendix.

The efficient signalling equilibrium characterized above for each of the three categories of firms specifies a *corresponding* pricing function $P(\alpha, D)$ used by the market to interpret the information content of insider trading and dividend changes. The announcement effects for the stock price which are implied by these pricing functions are derived in Proposition 2 (following, Section III).

The intuition behind the equilibrium can be seen in two steps. First, for a fixed α, say α_0, let us examine the logic behind the deviations from optimal investments in the signalling equilibrium. Take MP+ firms for concreteness. As indicated in the remarks following *Definition 1*, for this class of firms, the Pareto-optimal investment I^o is increasing in θ, i.e., $I^o(\theta_h)$ for the higher quality firm exceeds the corresponding investment $I^o(\theta_l)$ for the lower quality firm. Consider an investment $I^*(\theta_h) = I^o(\theta_h) + \delta$, $\delta > 0$ in the signalling equilibrium by the higher quality firm. To mimic this level of investment, the lower quality firm will have to invest $\delta + I^o(\theta_h) - I^o(\theta_l)$ above its Pareto-optimal level $I^o(\theta_l)$. Clearly the cost of this deviation for the lower quality firm exceeds that for the higher quality firm. On the other hand, a strategy of underinvesting, if pursued by the higher quality firm, will not impose larger costs of mimicking on the lower quality firm. Similar intuition applies for MP− firms and underinvestment. For MP0 firms, deviations from Pareto-optimal investment do not play a signalling role.

Now, the higher quality firm can also use increases in α beyond that required for optimal diversification for signalling purposes. Here the logic of nonmimicking by the lower quality firm is similar to that in Leland and Pyle (1977) and is valid for all three classes of firms. In the efficient signalling equilibrium the higher quality firm chooses the optimal mix of increases in α and deviations from Pareto-optimal investment to achieve nonmimicking by the lower quality firm at minimal cost.

For any observable activity A, if the full information optimal level of A, say $A^o(\theta)$ is increasing in θ, it can be shown that in the signalling equilibrium all but the poorest firm *overinvests* in A. Similarly if $A^o(\theta)$ is decreasing in θ, then there is *underinvestment* in the signalling equilibrium. This property is therefore a very general one and holds independent of the structure of the model, the nature of alternative signals, and the number of total signals available.

Two observations are noteworthy about this efficient signalling equilibrium, particularly in contrast to the Miller and Rock (1985) equilibrium. There, the higher quality firms underinvest more and pay larger dividends than their poor quality competitors. In our equilibrium, such a result obtains only in the case of MP− firms, where the marginal product of current investment is decreasing in θ. In other words, a higher dividend is taken by the uninformed market to be a signal of higher quality, conditional on the common knowledge information available in the market that the firms in question are MP− firms. For the remaining firms (MP0 or MP+ classes), the same signal of higher dividends may connote no differences in quality or poorer quality. The main observation here is that the dividend signals have to be interpreted by the market, conditional on the class of technologies of the signalling firms.

A second novel feature of our equilibrium is that we allow insiders to change their holdings strategically as a function of their private information. In most earlier signalling models, and all prior dividend signalling models, the insider (manager) is exogenously given a fraction of the firm, say α_0, and cannot revise that position based on his private information. For example, see Miller and Rock (1985) where insider holdings is fixed exogenously at $(1 - k)$ or Ross (1977) and Harris and Raviv (1985) where the managerial compensation functions have a similar effect. In our model, we allow the insider to obtain his private information and then optimally pick his holding $\alpha^*(\theta)$ conditional on his private information. This perspective of our model is important for testing its implications using data on insider trading.[8]

[8] Prior to receiving his private information, the manager is holding, say α_0, in his firm; he obtains his private information at $t = 0$ and then he announces a dividend level $D^*(\theta)$ and *revises* his holding in the firm to $\alpha^*(\theta)$, both conditional on his private information. $\{D^*(\theta), \alpha^*(\theta)\}$ are of course the efficient equilibrium signalling choices. The insider is a net buyer if $\alpha^*(\theta) > \alpha_0$ and a net seller if $\alpha^* < \alpha_0$. In either case the revision transaction $\alpha^*(\theta) - \alpha_0$ happens at the *signalled* price $P(D^*, \alpha^*)$. In other words, our insider trades from α_0 to $\alpha^*(\theta)$ based on his private information, fully realizing that the market price depends on the announced dividend and his trading.

III. Empirical Implications

To develop the empirical implications of our model, we begin by examining some properties of the pricing function $P(\alpha, D)$ which arise in the efficient signalling equilibrium. The cross-sectional relationship of P to insider holdings and dividend announcements are easily calculated. The announcement effects implied by these relationships form the basis for important empirically testable hypotheses.

Proposition 2: *The announcement effect of increases in insider holding $\partial P/\partial\alpha$ is positive for all classes of firms. The announcement effect of increases in dividends $\partial P/\partial D$ is positive for MP$-$ firms, zero for MP0 firms, and negative for MP$+$ firms.*

Proof: See Appendix.

The direct output of Proposition 2 is the comparative statics of the cross-sectional pricing function P. To link it to the event-day announcement effects, we proceed as follows. Focus on the announcement date which corresponds to $t = 0$ in our model. The less informed market has convinced itself that a signalling equilibrium will obtain and the equilibrium price schedule (to hold before and after announcement) is $P(\alpha, D)$, based on common-knowledge information about the technology (MP$+$, MP0, or MP$-$) of the signalling firm. *Prior to* the announcement (observation) of the signal levels, the market assigns to the firm an average price $\bar{P} = E_\theta[P(\alpha(\theta), D(\theta))]$. To assure consistency with the pricing schedule before announcement, the pre-announcement insider holdings and dividends would be $\hat{\alpha}$ and $\hat{D}$, such that $P(\hat{\alpha}, \hat{D}) = \bar{P}$.[9] At the time of announcement, insiders reveal their choices $\alpha^*(\theta)$ and $D^*(\theta)$. Now the pricing function of $P(\alpha, D)$ (as characterized in Proposition 2) determines the stock price conditional on the announced dividends and concurrent revision of insider holdings to $\alpha^*(\theta)$. In particular, if $\alpha^*(\theta) > \hat{\alpha}$, then $P > \bar{P}$, and if $\alpha^*(\theta) < \hat{\alpha}$, then $P < \bar{P}$. In other words, a higher (lower) final insider holding, i.e., net insider buying (selling), elicits a higher (lower) price than $\bar{P}$. Now let us examine the interpretation of dividend announcements. Here the common-knowledge information about the firm class (MP$-$, MP0, and MP$+$) is incorporated in $P(\alpha, D)$ as specified by the sign of $\partial P/\partial D$ in Proposition 2. For MP$-$ firms, $D^*(\theta) > \hat{D}$ implies $P > \bar{P}$, whereas for MP0 firms, $D^*(\theta) > \hat{D}$ implies $P = \bar{P}$, and for MP$+$ firms, $D^*(\theta) > \hat{D}$ implies $P < \bar{P}$, and so on. These implications provide the announcement effects. The intuition of the above argument is simply that as long as the pricing schedule $P(\alpha, D)$ remains the same before and after the announcement, changes in α or D would elicit an event-day price change as characterized in Proposition 2.

The announcement effect of dividends which is a function of the firm technology is a novel testable result of our model. By formulating empirical

[9] In general, since $P(\alpha(\theta), D(\theta))$ is not linear in θ, $\hat{\alpha} \neq \alpha(\bar{\theta})$ and $\hat{D} \neq D(\bar{\theta})$ where $\bar{\theta}$ is the mean value of θ.

proxies for firm technology classes, a direct test of Proposition 2 is possible. Lang and Litzenberger (1989) document that the stock price response to dividend changes for low Q firms (Tobin's Q ratio) is significantly more intense than that for high Q firms. This evidence is consistent with our model and is suggestive of a technology-dependent differential announcement effect of dividend changes. The above announcement effect of dividend increases is appealing for another reason. It formalizes, within the context of an information equilibrium, the informal suggestion that dividend increases may connote good news or bad news depending on the firm's investment opportunity set. All earlier works which study dividend announcement effects in an informational equilibrium predict a *positive* announcement effect for dividend increases (see Bhattacharya (1979), John and Williams (1985), Miller and Rock (1985), Ambarish, John, and Williams (1987), or Vishwanathan (1987)).

In the precise setting of our empirical tests, the market knows the extent and direction of insider trading before it observes the dividend announcement. In other words, the signals are sent sequentially (first insider trading, then dividend change) rather than simultaneously as implied by the set-up in the model. In this case, we also obtain the announcement effects as discussed above. Based on their private information θ, the insiders *choose* the optimal values for *both* signals $\alpha^*(\theta)$ and $D^*(\theta)$ at date $(s - 1)$ (*prior to* the dividend announcement day). First, the change in insider holdings from $\hat{\alpha}$ to $\alpha^*(\theta)$ is observed. The new price, which is conditioned only on the insider trading, is $P(\alpha^*(\theta), \hat{D}) \equiv \bar{P}(\hat{D})$ (which is different from $\bar{P}$).[10] If $\alpha^*(\theta) > \hat{\alpha}$, then $\bar{P}(\hat{D}) > \bar{P}$ (i.e., the price goes up), and if $\alpha^*(\theta) < \hat{\alpha}$, then $\bar{P}(\hat{D}) < \bar{P}$. On dividend announcement day, say on day s, $D^*(\theta)$ is also revealed to the market, and the price changes from $\bar{P}(\hat{D})$ to $P(\alpha^*(\theta), D^*(\theta))$ which incorporates the additional information conveyed by the dividend signal $D^*(\theta)$.[11] Again, the common knowledge about the firm class (MP − , MP0, and MP +) is used by the market in determining whether the price response should be positive, zero, or negative for an increase in dividend $D^*(\theta) > \hat{D}$. For example, for MP − firms, $D^*(\theta) > \hat{D}$ implies $P > \bar{P}(\hat{D})$, etc.

In the Proof of Proposition 2, we have derived in detail the price response to changes in insider holdings of common stock, with dividends (and corresponding investment) held constant. Insider buying or selling, as well as stock repurchases, equity issues, conversion to equity of convertible bonds, etc., lead to changes in insider holdings.[12] Transactions which increase

[10] Here we are assuming that the market's expectation of dividends conditional on the observed insider trading $\alpha^*(\theta)$ remains $\hat{D}$ or very close to it. In the empirical context of dividend *initiations* this is a plausible assumption. The market would have seen several instances of insider buying and selling in the past which were *not* accompanied by any changes in the firm's policy of no payouts.

[11] Note that the only assumption needed to interpret the case of the sequential release of signals using our model is that after date $(s - 1)$ when the signals are chosen the firm obtains no *further* private information until both signals are sequentially released (the second one on date s) to the market.

insider holdings (insider buying and stock repurchases) should elicit a positive price response, and this price response should be more intense the larger the parameters α, h, and σ^2 (see equation (A4) in the Appendix). Similarly, equity issues and bond conversions with declining insider holdings and insider selling should elicit a negative stock price response. Moreover, the response should be more intense for firms with large insider holdings α and large earnings variability σ^2 (as seen from equation (A4) in the Appendix). As detailed above, the announcement effect of dividend changes on stock price depends on firm technology, i.e., for MP− firms the announcement effect for dividend increases is the usual hypothesized positive one; but for MP0 firms the announcement effect is zero, and for MP+ firms the announcement effect is negative.

From the above arguments we derive testable implications relating insider trading and announcement effects of dividend changes. The efficient signalling equilibrium in Proposition 1 implies that insiders in MP− (MP+) firms with better than (worse than) average θ signal that to the market by increasing (decreasing) the insider shareholdings and by announcing a higher than expected dividend. This in turn implies that the following patterns should occur together: dividend increases should lead to (i) increases in stock price when accompanied by insider buying and (ii) decreases in stock price when accompanied by insider selling. For MP− class of firms, (i) obtains and for MP+ class of firms, (ii) holds.[13] However it should be noted that although we are able to characterize in detail the announcement effect of dividend increases and its direction of the price response for the three classes, our derivation does not give us a clear indication of its magnitude. For example, depending on the range of θ included in our sample, the positive price response may be large or small for the insider buying group (MP− class), and the negative price response large or small for the insider selling group (MP+ class).

Combining (i) and (ii) yields the following testable implication: in a subset of firms, higher-than-expected dividend announcements would elicit a positive stock price response (large or small) when concurrent with unexpected high insider buying. In *another* subset of firms, higher-than-expected dividend announcements would elicit a *negative* stock price response (large or small) when accompanied by unusually intense selling by insiders. Using

[12] Stock price responses consistent with these implications have been documented in detail in studies of equity issues and stock repurchases (e.g., Asquith and Mullins (1986), Masulis and Korwar (1986), Choi (1986), Dann (1981), Vermaelen (1981, 1984)). Vermaelen (1981, 1984) and Choi (1986) document some preliminary evidence consistent with $\partial P/\partial \alpha$ being positively related to α. In fact, Vermaelen (1984) finds the relationship between $\partial P/\partial \alpha$ and α (after controlling for the tender premium and the fraction repurchased) to be positive and significant. This should be contrasted with the relationship derived in Stulz (1988) where the firm value is concave in α and the supporting cross-sectional evidence in Morck, Shleifer, and Vishny (1988) and McConnell and Servaes (1989).

[13] There are symmetric patterns for dividend decreases, i.e., (i) holds for MP+ firms and (ii) holds for MP− firms.

data on dividend initiations and concurrent insider trading, we test the above prediction of our model. By categorizing firms based on insider trading activity immediately prior to the dividend initiation announcement, we examine the differential predictions for the stock price response. The empirical evidence is presented in Section IV.

IV. Empirical Evidence

In this section we test the implications of our model for patterns of insider trading and their impact on dividend announcement effects. Although the implications of our theoretical model are valid for announcements of dividend changes in general, we have chosen to study announcements of dividend *initiations*. Clearly, dividend initiations are an important dividend-increasing announcement for firms. For reasons detailed below in Section IV. D, dividend initiations provide a cleaner setting than routine dividend changes for studying the implications of our model.

A. Data on Dividend Initiations and Insider Trading

The dividend initiation data is obtained from the 1988 COMPUSTAT data base. The procedure for selecting the sample is to search for firms paying a cash dividend following at least 5 years of no cash dividend payments. The dividend initiation announcement dates are taken from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*.

Officers, directors, and principal stockholders who hold more than 10% of total common stocks outstanding are defined as insiders. The data on their trading records for this study comes from SEC insider trading tape. The tape contains all transactions by insiders from January 1975 to October 1985. Insider trading includes open market sales and purchases, private sales and purchases, exercises of options and warrants, shares acquired and disposed through a plan, gifts, stock dividends, exchange and conversions, redeemed, etc. In our definition of insider trading we include both insider open market transactions and private transactions. Such a definition is the same as the one used by the *Wall Street Journal* in the Insider Trading Spotlight table (see, e.g., on May 10, 1989) and the Value Line Investment Survey. Similar results are obtained for an alternative definition of insider trading which includes only insider open market transactions. Our sample contains 265 firms for which we could match the dividend initiation data with the insider trading data.[14] This sample covers the period from 1975 to 1985.

B. Construction of Insider Sale and Purchase Index

To investigate the impact of intensive insider trading on dividend initiation announcements, we construct a measure of standardized intensity of

[14] All our results hold, if we only use Value Line Investment Survey data. Such data is available for 72 of the 265 firms in our sample.

insider trading. Specifically, this measure will denote the net insider trading over a period of time prior to the dividend initiation announcements. Thus, the measure constructed below is specific to the time period over which the insider trades are aggregated and standardized. We will refer to these time periods as time period $1-t$, $t = 1, 2, 3, 4$. Time period $1-t$ refers to the period of t quarters length prior to event day (i.e., a time interval of t-quarters length prior to event day). Table I reports the summary statistics of insider trading in different time periods, $1-t$, $t = 1, 2, 3, 4$. The percentage of firms with insider purchases increases from 27.1% to 45.2% from time period 1–1 to 1–4, while that with insider sales goes from 26.8% to 42.8%. In our sample the total number of insider purchases goes from 135 to 311 from time period 1–1 to 1–4, whereas that of insider sales increases from 151 to 346.

Now consider the following Insider Sale and Purchase Index (*ISPI*1) in time period $1-t$

$$ISPI1 = (NP - NS)/(NP + NS)$$

where

NP = Aggregate number of insider purchase transactions in time period $1-t$, and

NS = Aggregate number of insider sale transactions in time period $1-t$.

The dollar volume of insider trading may serve as an alternative measure (see Seyhun (1988b), Hirschey and Zaima (1989), etc.). Consequently, a second Insider Sales and Purchase Index (*ISPI*2) in time period $1-t$ is

Table I

Summary Statistics of Insider Trading

Summary statistics of insider open market and private trading in time periods 1–1, 1–2, 1–3, and 1–4 which are 1, 2, 3, and 4 quarters, respectively, prior to dividend initiation. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. Insider transaction data is obtained from 1985 SEC Insider trading tape. The sample covers the period 1975–1985.

Time period	1–1	1–2	1–3	1–4
Number of firms in the sample	265	264	261	250
% of firms with insider purchases[a]	27.1%	35.6%	41.0%	45.2%
% of firms with insider sales[a]	26.8%	36.0%	39.8%	42.8%
Number of insider purchases[b]	135	217	276	311
Number of insider sales[b]	151	252	322	346

[a] Percentage of firms with insider purchases (sales) is measured as the percentage of firms in the sample which have at least one insider open market and/or private purchase (sale) in a given time period.

[b] Number of insider purchases (sales) is measured as the total number of insider open market and private purchases (sales) for firms in the sample in a given time period.

constructed as follows:

$$ISPI2 = (DSP - DSS)/(DSP + DSS)$$

where

DSP = Dollar amount of insider purchases in time period $1\text{-}t$, and
DSS = Dollar amount of insider sales in time period $1\text{-}t$.

Note that $ISPI1$ and $ISPI2$ are bounded in between -1 and 1. The scaling involved in the construction of the index may scale for the *size effect* in insider trading, i.e., firms with more insiders have more trades.[15] Since similar results are obtained for both $ISPI1$ and $ISPI2$, only those of $ISPI1$ are reported and discussed.

Given our method of scaling used in constructing $ISPI1$, it is possible that very high values of the index will result from a negligible amount of transactions. For instance, one insider sale and no insider purchase yields $ISPI1 = -1$, even though the total number of transactions is only one which may be too small to be informative. To filter out such cases we specify a threshold number of transactions such that a total number of insider transactions (number of sales plus number of purchases) below this threshold is referred to as a *no-trading* case and the corresponding $ISPI1$ is set to zero. Of course, such a threshold level would be a function of the length of the time period involved. We set the threshold level to be $A(t)$ for time period $1\text{-}t$, $t = 1, 2, 3, 4$, i.e., $A(1)$ in time period 1-1, $A(2)$ in time period 1-2, $A(3)$ in time period 1-3, and $A(4)$ in time period 1-4. We have experimented with the following 3 sets of thresholds; lower threshold ($A(1) = 1$, $A(2) = 2$, $A(3) = 3$, $A(4) = 4$), middle threshold ($A(1) = 1.5$, $A(2) = 3$, $A(3) = 4.5$, $A(4) = 6$), and higher threshold ($A(1) = 2$, $A(2) = 4$, $A(3) = 6$, $A(4) = 8$). The sample size for informative trading groups reduces substantially beyond the higher threshold. The use of such a threshold implies that the firms in the groups of $ISPI1 > 0$ and $ISPI1 < 0$ are firms with sizable differential insider purchases and sales respectively, whereas firms in the group of $ISPI1 = 0$ are those with zero and low levels of insider trading. As reported in Table II, the sample size in the lower threshold group for $ISPI1 > 0$ ranges from 34 to 39 and for $ISPI1 < 0$ ranges from 40 to 42. The sample size reduces from the lower threshold group to the higher threshold group. For instance, the corresponding sample size in the higher threshold group for $ISPI1 > 0$ is from 21 to 23 and for $ISPI1 < 0$ ranges from 25 to 26.

[15] Jaffe (1974b), Seyhun (1988a, 1988b), Rozeff and Zaman (1988), and others focus on the relation between intensive insider trading and stock market returns. According to Hirschey and Zaima (1989), popular publications such as *Insider's Chronicle* and *Insider Indicator* compute indications of insider trading activity based simply on the number of insider buy and sell decisions. It may be a reason to believe that investors consider unweighted measure of insider trading useful.

Table II

Description of Sample Size Associated with the *ISPI*1 Index and Time Period 1-t

The *ISPI*1 index equals $(NP - NS)/(NP + NS)$ if $(NP + NS)$ exceeds a pre-specified threshold and zero otherwise in time periods 1-t, $t = 1, \cdots, 4$. Time periods 1-1, 1-2, 1-3, and 1-4 are 1, 2, 3, and 4 quarters prior to dividend initiation. NP = number of insider open market and private purchases, NS = number of insider open market and private sales. We set the threshold levels to be $A(t)$ in time period 1-t, $t = 1, \cdots, 4$. We experiment with three sets of thresholds; lower threshold ($A(1) = 1$, $A(2) = 2$, $A(3) = 3$, $A(4) = 4$), middle threshold ($A(1) = 1.5$, $A(2) = 3$, $A(3) = 4.5$, $A(4) = 6$), and higher threshold ($A(1) = 2$, $A(2) = 4$, $A(3) = 6$, $A(4) = 8$). The *ISPI*1 index will be set to zero if $NP + NS$ is less than or equal to the threshold. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. Insider trading data is obtained from the 1985 SEC insider trading tape. The sample covers the period 1975-1985.

Threshold	Lower[a]		Middle[a]		Higher	
Insider Trading Index	*ISPI*1 > 0	*ISPI*1 < 0	*ISPI*1 > 0	*ISPI*1 < 0	*ISPI*1 > 0	*ISPI*1 < 0
Time period 1-1 (sample size = 265)	34	40	34	40	23	26
Time period 1-2 (sample size = 264)	38	42	28	33	22	26
Time period 1-3 (sample size = 261)	37	41	31	35	21	25
Time period 1-4 (sample size = 250)	39	41	33	34	22	26

[a] Sample sizes for the lower and middle threshold groups in time period 1-1 are the same due to the fact that the threshold $NP + NS \leq 1$ is the same as $NP + NS \leq 1.5$ (i.e., $NP + NS$ only picks up integers).

A few remarks regarding the characteristics of *ISPI*1 may be worth making.[16] First of all, market analysts maintain that insiders have more channels to acquire shares, such as stock options, warrants, etc., than to dispose of them. To rebalance their portfolios, insiders may be selling more than purchasing (as also shown in Table I). However, such higher insider sales may not be informative.[17] Similarly, some of the no-trade cases corre-

[16] Finnerty (1976a) concludes that firms in the group of substantial insider purchases are characterized by smaller size, larger earnings, and larger dividends when compared to those firms in the group of substantial insider sales. One-year and three-years averages (prior to event year) market value, earnings before interests and taxes scaled by total asset, and dividend yield in the groups of *ISPI*1 < 0, *ISPI*1 = 0 and *ISPI*1 > 0 from time period 1-1 to time period 1-4 are computed from 1988 COMPUSTAT data base but not reported. Similar characteristics as those observed by Finnerty (1976a) are obtained, while the overall results may not be statistically significant. In other words, relative to firms in the group of *ISPI*1 < 0, firms in the group of *ISPI*1 > 0 are characterized by smaller size, larger earnings, and larger dividend yield. The average fraction of insider holdings is around 20%, while little systematic trend or difference has been found across groups of *ISPI*1 $\gtreqless$ 0 in each time period.

[17] See "Does a decline in insider buying spell troubles for stock market?" *Wall Street Journal* (May 10, 1989).

sponding to $ISPI1 = 0$ may really be cases with net insider purchases based on their private information. In other words, insiders who acquired shares through a nonpurchase channel, such as option, warrants, etc., may not do the rebalancing sales because they are privy to positive information. This may suggest that the cases of no-trading (with $ISPI1 = 0$) are really cases of insider purchases. In our empirical tests we will study the no-trading cases independently as well as in combination with the insider purchase category (with $ISPI1 > 0$). Secondly, insider trades include trades by principal stockholders (defined as stockholders with a stake of 10% or more of common stock outstanding). Such stockholders may include someone who is about to make a tender offer, but who is really not an *insider*. Similar results are obtained without including trades by principal stockholders. Thirdly, some market analysts maintain that an aggregate insider purchase-to-sale ratio greater than 1.5 is a positive signal for the market, while a ratio less than 0.5 is a negative signal for the market.[18] The construction of $ISPI1$ is similar in spirit to the practitioners' purchase-to-sale ratio given that firms with noninformative trading are screened out.

C. Empirical Findings

To compute the announcement effect of dividend initiations, we follow standard procedure. We adjust the daily returns by the market model (estimated over -200 to -20 days prior to dividend initiation) to compute the daily abnormal return.[19] Note that half of the announcement dates of our sample firms are retrieved from the *Wall Street Journal Index* and the other half are retrieved from the CRSP Daily Master tape. Generally speaking, the *Wall Street Journal* dividend announcement date should be 1 business day after the CRSP Daily Master tape dividend announcement date. For consistency, day $t0$ is defined as the CRSP Daily Master tape announcement date and 1 business day prior to *Wall Street Journal Index* announcement date. However, since in some cases the *Wall Street Journal Index* announcement date coincides with the CRSP announcement date, the way we define the announcement date $t0$ may bias our analysis toward finding insignificant results. To alleviate this problem, we also employ the 2-day returns, over days $t0$ and $t1$ (1 business day after day $t0$), to compute the 2-day cumulative returns.[20] The abnormal return for our dividend initiations sample is reported in Table III. The abnormal return on day $t0$ is around 2.0% and the 2-day cumulative return (over the 2 days $t0$ and $t1$) is around 3.2%. This finding is consistent with the earlier dividend initiation studies by Asquith and Mullins (1983) (1-day abnormal return on day $t0$ is 2.5% and 2-day

[18] See "The insider track on stock," *Money* (December 1983); and "Heard on the street," *Wall Street Journal* (November 27, 1981).

[19] Similar results are obtained for value-weighted and equally-weighted market returns.

[20] The change of the stock price on dividend initiation day divided by dividend per share is also examined. As in Lang and Litzenberger (1989), less significant results are obtained.

Table III

The Announcement Effect of Dividend Initiation

The 1-day abnormal returns $R0$ and $R1$ on day 0 and day 1 (day 0 is the CRSP announcement day, day 1 is 1 business day after day 0) and 2-day cumulative abnormal return ($R01$) of day 0 and day 1 around dividend initiation. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. The return data is obtained from the 1988 CRSP Daily Return tape. We adjust the daily return by the market model estimated from -200 to -20 days prior to dividend initiation. t-statistics are computed using the cross-sectional standard deviation of firms in the sample. The sample comprises 265 firms and the period 1975-1985.

	Abnormal return	t-statistics
$R0$	1.97%	6.84
$R1$	1.27%	4.06
$R01$	3.23%	7.23

cumulative return is 3.7%) and by McCann (1988) (1-day abnormal return on day $t0$ is 1.60% and 2-day cumulative return is 3.0%).

Now we investigate the impact of *ISPI*1 on the announcement effect of dividend initiations. First, we examine a cross-sectional regression with one dummy variable to compare the excess returns of the negative *ISPI*1 group with those of the nonnegative (zero or positive) *ISPI*1 group. Here Dummy = 0 if $ISPI1 < 0$, and Dummy = 1 if $ISPI1 \geq 0$. The results are reported in Table IV. The coefficient of Dummy is significant at the 5% level. The average 1-day excess return and the 2-day cumulative return for the $ISPI1 \geq 0$ group are significantly higher than those for the group with $ISPI1 < 0$ (by about 2.1% for the 1-day return and 2.9% for the 2-day cumulative return).

We use a cross-sectional regression with two interactive dummy variables. Dummy1 = 1 times *ISPI*1 if $ISPI1 > 0$, and Dummy1 = 0 otherwise; Dummy2 = -1 times *ISPI*1 if $ISPI1 < 0$, and Dummy2 = 0 otherwise. Consequently, the constant in the cross-sectional regression corresponds to the average return of firms with $ISPI1 = 0$. The coefficients of Dummy1 and Dummy2 have the interpretation of the marginal returns for firms with $ISPI1 > 0$ and $ISPI1 < 0$, respectively, added to the average return for firms with $ISPI1 = 0$.

Table V reports the regression results. Overall, the constant terms are significant at the 1% level. The coefficient of Dummy1 is, overall, insignificant, while the coefficient of Dummy2 is significant at 5% level for either the one-day or the two-day average return regression in each time period. For firms in the group of $ISPI1 = 0$, the results suggest on average a 2.2% 1-day average excess return and a 3.3% 2-day cumulative return. For firms in the group of $ISPI1 > 0$ (i.e., Dummy1 = 1), we obtain very similar 1-day return and 2-day cumulative return as in the group of $ISPI1 = 0$. For firms in the

Table IV

Regression of Abnormal Return on Insider Trading Dummy Variable

Regression of 1-day abnormal return ($R0$) on day 0 (CRSP announcement day) and 2-day cumulative abnormal return ($R01$) of day 0 and 1 (1 business day after day 0) on dummy variable which builds on insider sale and purchase index *ISPI*1. The *ISPI*1 index equals $(NP - NS)/(NP + NS)$ if $(NP + NS)$ exceeds a pre-specified threshold and zero otherwise in time periods $1\text{-}t$, $t = 1, \cdots, 4$. Time periods 1-1, 1-2, 1-3, 1-4 are 1, 2, 3, and 4 quarters prior to dividend initiation, respectively. NP = number of insider open market and private purchases and NS = number of insider open market and private sales. Dummy = 1 if $ISPI1 \geq 0$, Dummy = 0 if $ISPI1 < 0$. We set the threshold levels to be $A(t)$ in time period $1\text{-}t$, $t = 1, \cdots, 4$. We experiment with three sets of thresholds; lower threshold ($A(1) = 1$, $A(2) = 2$, $A(3) = 3$, $A(4) = 4$), middle threshold ($A(1) = 1.5$, $A(2) = 3$, $A(3) = 4.5$, $A(4) = 6$), and higher threshold ($A(1) = 2$, $A(2) = 4$, $A(3) = 6$, $A(4) = 8$). The *ISPI*1 index will be set to zero if $NP + NS$ is less than or equal to the threshold. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. The return data is obtained from the 1988 CRSP Daily Return tape. We adjust the daily return by the market model estimated from −200 to −20 days prior to dividend initiation. Insider trading data is obtained from the 1985 SEC insider trading tape. The t-statistics are reported in the bracket, and R^2 is adjusted for degrees of freedom. The sample covers the period 1975–1985.

Time period	Sample size	Dependent variable	Lower threshold[a]			Middle threshold[a]			Higher threshold		
			Int.[b]	Dummy	R^2	Int.	Dummy	R^2	Int.	Dummy	R^2
1-1	265	$R0$	0.001	0.018	0.015	0.001	0.018	0.015	0.002	0.017	0.007
			(0.14)	(2.21)		(0.14)	(2.21)		(0.20)	(1.70)	
		$R01$	0.009	0.020	0.010	0.009	0.020	0.010	0.013	0.017	0.001
			(0.85)	(1.85)		(0.85)	(1.85)		(0.86)	(1.15)	
1-2	264	$R0$	−0.001	0.023	0.022	−0.001	0.022	0.015	0.001	0.020	0.010
			(0.09)	(2.59)		(0.07)	(2.23)		(0.07)	(1.91)	
		$R01$	−0.002	0.037	0.025	−0.002	0.037	0.019	−0.005	0.040	0.019
			(0.12)	(2.75)		(0.16)	(2.44)		(0.33)	(2.44)	
1-3	261	$R0$	0.000	0.022	0.020	−0.002	0.024	0.021	−0.006	0.028	0.023
			(0.03)	(2.48)		(0.23)	(2.53)		(0.62)	(2.66)	
		$R01$	0.004	0.031	0.017	−0.001	0.036	0.020	0.000	0.034	0.013
			(0.32)	(2.30)		(0.05)	(2.47)		(0.03)	(2.08)	
1-4	250	$R0$	0.006	0.016	0.009	0.002	0.021	0.014	0.000	0.022	0.012
			(0.73)	(1.79)		(0.17)	(2.12)		(0.03)	(2.03)	
		$R01$	0.012	0.024	0.008	0.014	0.020	0.003	0.013	0.021	0.003
			(0.91)	(1.71)		(0.98)	(1.36)		(0.81)	(1.29)	

[a] Regression results for the lower and middle threshold groups in time period 1-1 are the same due to the fact that the threshold $NP + NS \leq 1$ is the same as $NP + NS \leq 1.5$ (i.e., $NP + NS$ only picks up integers).

[b] Intercept.

group of $ISPI1 < 0$ (i.e., Dummy2 = 1) the constant term suggests on average a −0.5% 1-day excess return and a −0.3% 2-day cumulative return.[21]

Note that the t-statistics of Dummy2 across time period 1-1 to time period 1-4 in Table V are quite similar. This suggests on the one hand that

[21] The above figures are obtained by averaging the corresponding coefficients across 4 time periods.

Table V

Regression of Abnormal Return on Interactive Insider Trading Dummy Variables

Regression of 1-day abnormal return ($R0$) on day 0 (CRSP announcement day) and 2-day cumulative abnormal return ($R01$) of day 0 and 1 (1 business day after day 0) on two interactive dummy variables which build on insider sale and purchase index $ISPI1$. The $ISPI1$ index equals $(NP - NS)/(NP + NS)$ if $(NP + NS)$ exceeds a pre-specified threshold and zero otherwise in time periods $1\text{-}t$, $t = 1, \cdots, 4$. Time periods 1-1, 1-2, 1-3, 1-4 are 1, 2, 3, and 4 quarters prior to dividend initiation, respectively. NP = number of insider open market and private purchases and NS = number of insider open market and private sales. Dummy1 = 1 times $ISPI1$ if $ISPI1 > 0$ and zero otherwise, Dummy2 = -1 times $ISPI1$ if $ISPI1 < 0$ and zero otherwise. We set the threshold levels to be $A(t)$ in time period $1\text{-}t$, $t = 1, \cdots, 4$. We experiment with three sets of thresholds; lower threshold ($A(1) = 1$, $A(2) = 2$, $A(3) = 3$, $A(4) = 4$), middle threshold ($A(1) = 1.5$, $A(2) = 3$, $A(3) = 4.5$, $A(4) = 6$), and higher threshold ($A(1) = 2$, $A(2) = 4$, $A(3) = 6$, $A(4) = 8$). The $ISPI1$ index will be set to zero if $NP + NS$ is less than or equal to the threshold. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. The return data is obtained from the 1988 CRSP Daily Return tape. We adjust the daily return by the market model estimated from -200 to -20 days prior to dividend initiation. Insider trading data is obtained from the 1985 SEC insider trading tape. The t-statistics are reported in the bracket, and R^2 is adjusted for degrees of freedom. The sample covers the period 1975–1985.

Time period	Sample size	Dependent variable	Lower threshold[a]				Middle threshold[a]				Higher threshold			
			Int.[b]	Dummy1	Dummy2	R^2	Int.	Dummy1	Dummy2	R^2	Int.	Dummy1	Dummy2	R^2
1-1	265	$R0$	0.020	−0.010	−0.021	0.013	0.020	−0.010	−0.021	0.013	0.019	0.001	−0.021	0.002
			(7.42)	(0.87)	(2.20)		(7.42)	(0.87)	(2.20)		(7.07)	(0.07)	(1.60)	
		$R01$	0.030	0.009	−0.025	0.007	0.030	0.009	−0.025	0.007	0.028	0.021	−0.017	−0.001
			(7.43)	(0.51)	(1.81)		(7.43)	(0.51)	(1.81)		(7.19)	(0.96)	(0.87)	
1-2	264	$R0$	0.022	−0.000	−0.029	0.012	0.021	0.002	−0.028	0.008	0.021	−0.002	−0.025	0.003
			(7.31)	(0.01)	(2.23)		(7.30)	(0.14)	(1.98)		(7.29)	(0.14)	(1.63)	
		$R01$	0.035	0.000	−0.047	0.014	0.033	0.021	−0.047	0.013	0.033	0.013	−0.055	0.015
			(7.70)	(0.01)	(2.39)		(7.57)	(0.77)	(2.13)		(7.72)	(0.47)	(2.34)	
1-3	261	$R0$	0.022	−0.003	−0.026	0.012	0.022	−0.005	−0.029	0.014	0.022	−0.009	−0.029	0.011
			(7.39)	(0.18)	(2.27)		(7.49)	(0.30)	(2.34)		(7.51)	(0.47)	(2.14)	
		$R01$	0.035	−0.003	−0.036	0.009	0.035	−0.007	−0.042	0.012	0.034	0.007	−0.038	0.006
			(7.67)	(0.15)	(2.05)		(7.83)	(0.28)	(2.25)		(7.67)	(0.21)	(1.85)	
1-4	250	$R0$	0.022	0.002	−0.024	0.009	0.023	−0.011	−0.028	0.012	0.022	−0.007	−0.028	0.009
			(7.34)	(0.12)	(2.03)		(7.62)	(0.66)	(2.18)		(7.57)	(0.36)	(2.06)	
		$R01$	0.036	−0.006	−0.036	0.008	0.035	−0.014	−0.031	0.002	0.035	−0.002	−0.033	0.002
			(7.69)	(0.27)	(1.97)		(7.67)	(0.55)	(1.54)		(7.67)	(0.08)	(1.56)	

[a] Regression results for the lower and middle threshold groups in time period 1-1 are the same due to the fact that the threshold $NP + NS \leq 1$ is the same as $NP + NS \leq 1.5$ (i.e., $NP + NS$ only picks up integers).

[b] Intercept.

significant insider trading activity on the dividend initiation announcement effect can be captured at least within a year prior to the event. On the other hand, the second, third, and fourth quarters insider sales may add little marginal impact to the average impact of the first quarter insider sales. To confirm this conjecture, *ISPI*1 is reconstructed for the first quarter (time period 1), second quarter (time period 2), third quarter (time period 3), and fourth quarter (time period 4) prior to dividend initiation.[22] Recall that the threshold level is a function of the length of the time period. Since we only investigate each of the 4 quarters prior to dividend initiation, the three thresholds remain the same across time period 1 to time period 4. We set the lower, middle, and higher thresholds to be 1, 1.5, and 2, respectively. *ISPI*1 is set to zero if the total insider sales plus purchases is equal to or less than the threshold. Since the lower threshold 1 and the middle threshold 1.5 yield identical *ISPI*1 values, only those with lower and higher thresholds are reported. As shown in Table VI, the sample size for the lower (middle) threshold group for *ISPI*1 > 0 is 34 in time period 1 and is restored to 35

Table VI

Description of Sample Size Associated with the *ISPI*1 Index and Time Period *t*

The *ISPI*1 index equals $(NP - NS)/(NP + NS)$ if $(NP + NS)$ exceeds a pre-specified threshold and zero otherwise in time periods t, $t = 1, \cdots, 4$. Time periods 1, 2, 3, and 4 are the first, second, third and fourth quarter prior to dividend initiation. NP = number of insider open market and private purchases, NS = number of insider open market and private sales. We set the threshold levels to be $A(t)$ in time period t, $t = 1, \cdots, 4$. We experiment with three sets of thresholds; lower threshold ($A(1) = 1$, $A(2) = 1$, $A(3) = 1$, $A(4) = 1$), middle threshold ($A(1) = 1.5$, $A(2) = 1.5$, $A(3) = 1.5$, $A(4) = 1.5$), and higher threshold ($A(1) = 2$, $A(2) = 2$, $A(3) = 2$, $A(4) = 2$). The *ISPI*1 index will be set to zero if $NP + NS$ is less than or equal to the threshold. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. Insider trading data is obtained from the 1985 SEC insider trading tape. The sample covers the period 1975–1985.

Threshold	Lower (Middle)[a]		Higher	
Insider trading index	*ISPI*1 > 0	*ISPI*1 < 0	*ISPI*1 > 0	*ISPI*1 < 0
Time period 1 (sample size = 265)	34	40	23	26
Time period 2 (sample size = 264)	32	39	20	25
Time period 3 (sample size = 261)	27	37	17	21
Time period 4 (sample size = 255)	35	30	20	22

[a] Sample sizes for the lower and middle threshold groups from time period 1 to time period 4 are the same due to the fact that the threshold $NP + NS \leq 1$ is the same as $NP + NS \leq 1.5$ (i.e., $NP + NS$ only picks up integers).

[22] *ISPI*1 is the same for time period 1–1 and time period 1.

after a small drop in time periods 2 and 3. The sample size in the same group for $ISPI1 < 0$ decreases from 40 in time period 1 to 30 in time period 4. The sample size in the higher threshold group for $ISPI1 > 0$ drops from 23 to 20 and for $ISPI1 < 0$ decreases from 26 to 22.

Two interactive dummy variables are used in the cross-sectional regressions. Dummy$A$ = 1 times $ISPI1$ if $ISPI1 > 0$, Dummy$A$ = 0 otherwise. Dummy$B$ = -1 times $ISPI1$ if $ISPI1 < 0$, Dummy$B$ = 0 otherwise. Regression results are reported in Table VII. The coefficient of Dummy$A$ is overall insignificant across different time periods, while the coefficient of Dummy$B$ is significantly negative in time periods 1 and 2 but not in time periods 3 and 4. This evidence indicates that insider sales captured by Dummy2 in time periods 1 and 2 in Table V drive the results, while insider sales captured by Dummy2 in time periods 3 and 4 only add insignificantly to the effect of the first and second quarter insider sales.

D. Discussion of Findings

Even though our theoretical model and its implications apply to routine dividend changes as well as dividend initiations, dividend initiations provide a cleaner empirical setting for our tests. Given the noise present in the insider trading data, we use measures of insider trading based on aggregating the trades over periods of a quarter to 4 quarters. In this context, a major event in the life of the firm such as dividend initiation provides a better setting than routine dividend changes which could be as close as a quarter apart. If we were to focus only on *major* dividend changes, then the choice of these major changes would be arbitrary, and, in addition, the confounding effects of *nonmajor* dividend changes would be inevitable. Moreover, the problem of determining the market's conditional expected dividend (conditional on observed insider trading) becomes severe (see footnote 10).

Our empirical findings can be summarized as follows. The announcement effect of dividend initiations (which can be thought of as unexpected dividend increases) is affected by the extent and direction of insider trading activity during the quarter prior to the announcement date. In other words, the market seems to interpret the information content of the dividend initiation conditional on the nature of the insider trading activity prior to the announcement. Contrary to the existing notion from earlier studies, all dividend initiations do not convey *good news*. For the subgroup with $ISPI1 \geq 0$, the excess return is significantly positive and significantly higher than the group with $ISPI1 < 0$. Such a differential announcement effect is largely consistent with the main prediction of our model. However, it should be noted that the announcement effect for the insider buying group is positive and significant, while the average excess return for the insider selling group is negative but not significantly different from zero. As we argued at the end of Section III, it is possible that the positive price response to dividend changes for the MP$-$ group (with insider buying) is large and the negative price response for the MP$+$ group (with insider selling) small. Thus, this part of

Table VII

Regression of Abnormal Return on Interactive Insider Trading Dummy Variable

Regression of 1-day abnormal return ($R0$) on day 0 (CRSP announcement day) and 2-day cumulative abnormal return ($R01$) of day 0 and 1 (1 business day after day 0) on two interactive dummy variables which build on insider sale and purchase index $ISPI1$. The $ISPI1$ index equals $(NP - NS)/(NP + NS)$ if $(NP + NS)$ exceeds a prespecified threshold and zero otherwise in time periods t, $t = 1,\cdots,4$. Time periods 1, 2, 3, 4 are the first, second, third and fourth quarter prior to dividend initiation, respectively. NP = number of insider open market and private purchases and NS = number of insider open market and private sales. Dummy$A$ = 1 times $ISPI1$ if $ISPI1 > 0$ and zero otherwise. Dummy$B$ = -1 times $ISPI1$ if $ISPI1 < 0$ and zero otherwise. We set the threshold levels to be $A(t)$ in time period t, $t = 1,\ldots,4$. We experiment with three sets of thresholds; lower threshold ($A(1) = 1$, $A(2) = 1$, $A(3) = 1$, $A(4) = 1$), middle threshold ($A(1) = 1.5$, $A(2) = 1.5$, $A(3) = 1.5$, $A(4) = 1.5$), and higher threshold ($A(1) = 2$, $A(2) = 2$, $A(3) = 2$, $A(4) = 2$). The $ISPI1$ index will be set to zero if $NP + NS$ is less than or equal to the threshold. Dividend initiation data is obtained from the 1987 CRSP Daily Master tape and the *Wall Street Journal Index*. The return data is obtained from the 1988 CRSP Daily Return tape. We adjust the daily return by the market model estimated from -200 to -20 days prior to dividend initiation. Insider trading data is obtained from the 1985 SEC insider trading tape. The t-statistics are reported in the bracket, and R^2 is adjusted for degrees of freedom. The sample covers the period 1975-1985.

Time period	Sample size	Dependent variable	Lower (Middle) threshold[a] Int.[b]	Dummy$A$	Dummy$B$	R^2	Higher threshold Int.	Dummy$A$	Dummy$B$	R^2
1	265	$R0$	0.020	−0.010	−0.021	0.011	0.019	0.001	−0.021	0.002
			(7.42)	(0.87)	(2.20)		(7.07)	(0.07)	(1.60)	
		$R01$	0.030	0.009	−0.025	0.007	0.028	0.021	−0.017	−0.001
			(7.43)	(0.51)	(1.81)		(7.19)	(0.96)	(0.87)	
2	264	$R0$	0.021	0.010	−0.021	0.011	0.021	0.003	−0.022	0.004
			(7.06)	(0.85)	(1.98)		(7.23)	(0.19)	(1.69)	
		$R01$	0.034	0.010	−0.033	0.011	0.033	0.025	−0.047	0.018
			(7.50)	(0.54)	(2.10)		(7.61)	(1.03)	(2.32)	
3	261	$R0$	0.021	0.009	−0.013	0.000	0.021	−0.001	−0.024	0.003
			(7.01)	(0.59)	(1.29)		(7.33)	(0.06)	(1.65)	
		$R01$	0.033	0.009	−0.012	−0.005	0.033	−0.010	−0.020	−0.004
			(7.25)	(0.39)	(0.79)		(7.57)	(0.32)	(0.91)	
4	255	$R0$	0.021	−0.002	−0.017	−0.001	0.021	−0.005	−0.019	−0.001
			(7.19)	(0.18)	(1.29)		(7.34)	(0.29)	(1.31)	
		$R01$	0.033	0.007	−0.009	−0.007	0.033	−0.006	0.000	−0.008
			(7.12)	(0.40)	(0.46)		(7.32)	(0.24)	(0.02)	

[a] Regression results for lower and middle threshold groups are the same due to the fact that the threshold $NP + NS \leq 1$ is the same as $NP + NS \leq 1.5$ (i.e., $NP + NS$ only picks up integers).

[b] Intercept.

the evidence is also consistent with our predictions. In the region $ISPI1 < 0$, the announcement day excess return is decreasing in $|ISPI1|$, and the slope coefficient is significantly different from zero. If $ISPI1 = -1$, the 1-day excess return is negative. On the other hand, for the region $ISPI1 \geq 0$, the announcement day excess return has a flat relationship with $ISPI1$, i.e., the slope of the relationship is insignificantly different from zero. However, for the entire range of values of $ISPI1 \geq 0$, the 1-day excess return is around 2.2% and the two-day cumulative return is 3.3% on average. Thus, the evidence seems to be consistent with our prediction that the information content of dividend increases should be read in conjunction with the second signal, i.e., insider trading. For firms which increase dividends and increase insider holdings beyond what is expected, the price effect should be positive. For firms which increase dividends and decrease insider holdings, the price effect should be negative.

It is worth pointing out that the differential announcement effect of dividend initiations that we document cannot be explained by any of the existing signalling models. In particular, a sequential application of two one-signal models such as Leland and Pyle (1977) for the insider trading signal and Miller and Rock (1985) or John and Williams (1985) for the dividend signal would still lead to the prediction that the excess returns on day of initiation announcement should be independent of the insider trading which precedes it. With these models, the effect of insider trading should already be reflected in the prices, so the dividend initiation announcement has an independent incremental effect. In contrast, our model here predicts that the market's interpretation of the dividend initiation should be conditioned on the class of firm technologies, which in turn is picked up by the direction of insider trading.

The announcement effect of dividend initiation is positive for the subgroup of firms with $ISPI1 = 0$. In the context of our model, there are two alternative interpretations. One interpretation implies that this subgroup of firms really contains a large number of cases with *effective* insider purchases as argued in Section IV. *B*. In this case, the evidence is directly consistent with Proposition 2. The other interpretation implies that for certain range of values of the private information θ, the equilibrium insider holdings $\alpha^*(\theta)$ is not very responsive to θ, while equilibrium dividend value $D^*(\theta)$ is. In other words, for a change $d\theta$ in θ, $\alpha^*(\theta + d\theta) \approx \alpha^*(\theta)$, but $D^*(\theta + d\theta)$ is quite different from $D^*(\theta)$. If $\hat{\theta}$, the current private information happens to be in such a range, for small changes in θ, dividend changes are the dominant signal while insider trading is secondary. Since our definition of the subset $ISPI1 = 0$ includes cases with small levels of insider trading, the documented positive announcement effect is consistent with a range of θ values for which the optimal signalling mix is dominated by dividends. In such cases, dividend is effectively the only signal being used and there is no appreciable insider trading. It can be argued that this part of the evidence is also consistent with the earlier dividend signalling models such as Bhattacharya (1979), Miller and Rock (1985), and John and Williams (1985) which predict a positive response for dividend increases. Even though these earlier models do not allow insider trading it could be argued that such a restriction is not binding for the subgroup of firms with $ISPI1 = 0$, i.e., firms whose insiders optimally chose not to trade.

V. Conclusion

In this paper we study some informational aspects of insider trading around corporate dividend announcements. Since the focus is on the announcement effect of dividend changes on stock prices, a natural theoretical framework for the study is a signalling model. Modelling trading by corporate insiders (subject to disclosure regulation) as a signalling activity, we examine its interaction in equilibrium with the other signal, i.e., dividend announcements. The equilibrium characterization of the choice of signals and the pricing function yields several novel testable implications.

One interesting implication of our model is that the information content of a dividend change, say, a dividend increase, depends crucially on the investment opportunity set of the signalling firm. While it is *good news* for MP − firms, it is *bad news* for MP + firms. This result formalizes the intuitive notion that dividend policy changes initiated by growth firms may be interpreted by the market differently from those initiated by mature firms.

The model also yields detailed announcement effects of dividend changes and changes in insider holdings (resulting from stock repurchases, equity issues, conversion to equity of convertible bonds, as well as insider buying or selling). In addition to the direction of the stock price response, the dependence of its intensity on (i) current insider holdings, (ii) variance of firm cash flows, (iii) entrepreneurial risk aversion, and (iv) the class of firm technology (MP + , MP0, or MP −) is explicitly characterized. With appropriate empirical proxies for the relevant variables, the above relationships provide several testable implications.

One of the most notable features of our model is its characterization of the effect of insider trading on the announcement effect of dividends. A novel implication of our model is that the announcement effect of dividend *increases* may be positive or negative depending on the concurrent insider trading. For firms with net insider selling, the stock price response should be negative, for others, positive.

We present evidence on the announcement effect of dividend initiations that shows that insider trading prior to the announcement has significant explanatory power. The announcement effect (1-day excess return) for the insider selling group is about 2.2% less than that of the remaining group. Such a differential announcement effect is robust. Similar results are obtained for different measures of insider trading, including and excluding trades by principal stockholders and for three different threshold levels (which define *no-trade* cases). Other evidence suggests that the excess return for the intense selling group is negative whereas for the intense buying group it is positive. The positive announcement effect for the subgroup with no insider trading seems to suggest either that this subgroup contains cases which are *effectively* insider purchases or that dividends may be the dominant signal (and insider trading a secondary signal) within certain ranges of firm quality.

Overall, the evidence seems to be consistent with the patterns of insider trading activity and stock price response predicted by our model with multiple signals. Our theory and evidence suggest that viewing insider trading as a signalling activity, jointly with corporate dividend signals, may be a useful perspective to understand insider trading around corporate dividend announcements and the attendant price effects.

Appendix

Proof of Proposition 1: An outline of the proof is sketched below. The detailed steps of the proof can be constructed using parallel steps in the *Proof of Proposition 1* of John and Mishra (1990) (see remarks at end of Section I).

The strategy is to formulate the efficient signalling problem and construct the equilibrium for the restricted case of two types of firms and extrapolate. Let $\Theta = \{\theta_1, \theta_2\}$, $\theta_2 > \theta_1$. θ_j, $j = 1, 2$, be the values of the private information attribute. Denote $f(I, \theta_j) \equiv f_j(I)$. Recall that, for all feasible investments $I \geq 0$, we have the function f_j that is continuously differentiable, strictly increasing, and strictly concave, with corner conditions $f_j'(0) = \infty$. Given $\theta_2 > \theta_1$, we also have $f_2(I) > f_1(I)$ for all $I \geq 0$. Further denote $\Delta(I) = f_2'(I) - f_1'(I)$. *Definition 1* implies that a class of MP+ firms is characterized by $\Delta(I) > 0$ for all $I \geq 0$, a class of MP0 firms by $\Delta(I) = 0$ for all $I \geq 0$, and a class of MP− firms by $\Delta(I) < 0$ for all $I \geq 0$.

To characterize the efficient signalling equilibrium the standard procedure is to transform the problem into an equivalent nonmimicry problem. In the nonmimicry problem insiders in more valuable firms choose their holdings and dividend levels to maximize their true (full-information) welfare, subject to a nonmimicry constraint. This constraint stipulates that the welfare attained by the insiders in less valuable firms by implementing full-information-optimal shareholding and dividend policies exceeds the welfare attained by mimicking the policies of the more valuable firm to realize in the market their higher stock price.

Denote by α_j^o and D_j^o the resulting symmetric-information solution for firm j. The insiders diversify optimally under symmetric information: $\alpha_j^o = 0$, $j = 1, 2$. Also the optimal dividend D_j^o is picked such that $D_j^o = C - I_j^o$ where I_j^o uniquely satisfies the familiar first-order condition:

$$1 = f_j'\left(I_j^o\right), \tag{A1}$$

i.e., insiders in firm j invest in all projects with nonnegative NPV.

Now we can characterize the signal choices of firms, $\{\alpha_j^*, D_j^*\}$, $j = 1, 2$, in the efficient signalling equilibrium. For firm 1, the solution coincides with that under symmetric information $\alpha_1^* = 0$, $D_1^* = D_1^o$. The choices of the more valuable firms are characterized by the first-order conditions of firm 2's constrained optimization implied by the nonmimicry problem. It can be shown that $\alpha_2^* > 0$ and

$$\operatorname{sign} \Delta\left(I_2^*\right) = \operatorname{sign}\left(1 - f_2'\right). \tag{A2}$$

The condition (A2) characterizes the investment policy I_2^* and the dividend policy $D_2^* = C - I_2^*$ of the higher quality firm (of type θ_2) in the efficient signalling equilibrium. Here the right hand side of (A2) characterizes whether the signalling-equilibrium-level of investment I_2^* represents overinvestment, full-information optimal investment, or underinvestment, i.e.,

$$\operatorname{sign} \Delta\left(I_2^*\right) = \operatorname{sign}\left(I_2^* - I_2^o\right). \tag{A3}$$

Using equations (A2) and (A3) we can directly characterize the investment policy I_2^* of all but the poorest firms (recall $I_1^* = I_1^o$) in terms of their technologies, i.e., MP+ , MP0, or MP−. The results of the two-type case extend to the case of multiple types (where the cardinality of Θ is larger than 2). In this general case, $\frac{\partial^2 f}{\partial I\, \partial \theta}$ plays the same role as Δ. Q.E.D.

Proof of Proposition 2: From among the many pricing functions which can support the equilibrium, choose a differentiable function P. Next, compute the necessary conditions from the original optimization (1) of the insiders in the text, given the pricing function P. Rearrange the results to obtain $\frac{\partial P}{\partial \alpha}$ and $\frac{\partial P}{\partial D}$ evaluated at $\alpha^*(\theta)$ and $I^*(\theta)$ as follows:

$$\frac{\partial P}{\partial \alpha} = \frac{\alpha}{1-\alpha} h \sigma^2 \tag{A4}$$

$$\frac{\partial P}{\partial D} = \frac{-\alpha}{1-\alpha}\left(1 - f_2'\right). \tag{A5}$$

For $0 < \alpha < 1$, $\frac{\partial P}{\partial \alpha} > 0$ for all classes of firms. The announcement effect of dividend increases depends on the sign of $\frac{\partial P}{\partial D}$ in (A5): sign $\frac{\partial P}{\partial D} = -\operatorname{sign}(1 - f_2')$, which is determined by sign $\Delta(I_2^*)$ via (A2). This, in turn, is determined by the technology classes. Q.E.D.

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