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INSIDER TRADING AND THE VALUE OF THE FIRM*

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Previous studies of insider trading have examined the profitability to executives of their stock trading with a view to evaluating the informational efficiency of securities markets. We examine empirically whether insider trading raises or lowers firm value. To correctly identify the effects on firm value at the margin, we correct for the simultaneity of earnings, insider holdings, and the amount of insider trading. We explicitly deal with simultaneity by using a two-part testing procedure. Our results suggest that insider *trading* lowers the value of the firm at the margin, but that greater executive stock *ownership* raises the value.

I. INTRODUCTION

THE TOPIC of insider trading continues to generate controversy despite over two decades of empirical research.[1] Earlier empirical work tried to document the extent of insider trading and assess the informational efficiency of securities markets.[2] Insider profits serve as a guide to the efficiency of stock markets. Abnormal insider profits would violate the strong form of the efficient market hypothesis.[3] Similarly, the existence of abnormal profits to "outsiders" who merely duplicate the actions of insiders using published information is anomalous in that it leads to a violation of semi-strong form market efficiency. Unlike these studies, we empirically test whether insider trading affects firm value.[4]

The best evidence to date suggests that the extent of insider trading is important and that insiders obtain significant abnormal returns from their trading, but there is still a great deal of debate concerning the ability of

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[1] See Manne [1966], Lorie and Niederhoffer [1968], Pratt and DeVere [1970], Jaffe [1974a, 1974b], Finnerty [1976a, 1976b], Givoly and Palmon [1985], Seyhun [1986, 1988] and Rozeff and Zaman [1988].

[2] Insider trading in this paper refers to executive stock trading based upon inside information. The legal definition is more narrow.

[3] Strong form efficiency requires that security prices impound all public and private information. A weaker form of efficiency is semi-strong form efficiency, where security prices reflect all publicly available information. The least stringent definition of efficiency is weak-form efficiency, where security prices impound only all past price information.

[4] The only studies we are aware of that empirically test whether executive incentives affect firm performance are Masson [1969, 1971] using the data we use here and Abowd [1990] for a sample of middle management.

outsiders to profitably mimic the actions of insiders.[5] From the viewpoint of public policy, however, an important question concerns the economic effects of insider trading; a subject which has not been addressed empirically before. There is a strong public policy presumption that insider trading should be discouraged; that it lowers firm value and is "unfair" to traders who do not have this information.[6]

This paper examines empirically whether insider trading by a firm's top (three to five) executives raises or lowers firm value. We distinguish between executive stock ownership and trading. In a stylized theoretical model we show that even if insider trading increases firm value, insider trading is deleterious at the margin.

The fundamental problem for measuring the impact of insider trading on firm value is that the level of trading may already be capitalized, or that owners may have designed incentives to achieve an "optimal level" of insider trading. Empirical tests may be unable to detect the impact of insider trading on firm value if stockholders have devised executive compensation schemes to minimize the effect of insider trading. We do not pursue the question of whether such schemes are in fact implementable, although we suggest some reasons why this may not be the case. Rather, our approach is to analyze a dataset drawn from a period when it is unlikely (for reasons we elaborate upon below) that rational expectations on the part of stockholders could eliminate the observed effects of insider trading. The dataset consists of observations of executive stock trades for the period 1946–1968, and is particularly useful for analyzing insider trading by corporate executives, as described in section III below.

A related estimation problem arises because executive earnings, stockholdings and the level of insider trading are jointly determined. We both examine the structure of executive earnings and develop an index of insider trading. The trading index is based upon stock sales (purchases) prior to stock price decreases (increases). Using these estimates we next construct a test of efficiency. The results support the hypothesis that *active use of insider information* in stock trading by executives *lowers firm value.* However *greater stock ownership* by executives *raises firm value.*

The paper proceeds as follows. In section II we provide a simple model of executive incentives and insider trading. The empirical model is developed in section III. We conclude with some policy implications in section IV.

[5] Seyhun [1986, 1988] provides evidence that outsiders cannot make abnormal profits (either at the individual firm level or at the market level) by emulating insiders when transactions costs and lags are taken into account. Rozeff and Zaman [1988] argue that abnormal returns to published insider trading data may reflect the failure of empirical researchers to control for size effects in the sample of firms.

[6] Some executives may actually destabilize firm performance (or information about performance) to take advantage of stock price swings. Others may merely take advantage of profit opportunities in the market for the company's financial assets.

II. INSIDER TRADING AND THE VALUE OF THE FIRM

There are several interconnected issues to address in assessing insider trading. These include equity and the fiduciary role of executives, the influence of insider traders' *executive decisions*, and their role as "informed traders" in stock market efficiency.[7]

There are several possible theories of how firm value may depend on the amount of insider trading. Allowing executives to trade using inside information may lower long-term firm value by providing incentives for them to engage in destabilizing fluctuations in the company's stock price. Firm value may be directly lowered if this entails altering investment and production decisions or real costs. Firm value could also be lowered because potential investors with rational expectations recognize that insider trading is costly to them. Insiders reduce the *ex ante* profits of investors without private information since any individual stock trade is a zero-sum game. Perceptions of insider trading may reduce the liquidity of the market for the firm's stock, making it difficult for a corporation to raise funds to undertake positive net present value projects. Increased insider profits has a secondary effect on firm value through transaction costs. The bid-ask spread reflects the trading floor costs of "market makers" who stand ready to buy and sell securities on demand.[8] Glosten and Milgrom [1985] show that the presence of informed traders widens their bid-ask spread, since market makers suffer expected losses when trading with informed traders and must recoup their losses from trades with uninformed agents. Both effects may reduce the attractiveness of the stock and hence lower firm value. Manove [1989] presents a model where the presence of insider traders leads to distortions in investment, reducing welfare.[9]

Henry Manne [1966] countered both the equity and efficiency arguments against unrestricted executive stock trading. He correctly argues that the value of the firm is often enhanced if private information is not released. For example, if a new mineral strike is announced before the surrounding land is purchased, potential economic rents will be transferred from the stockholders to the landowners. Yet, stockholders who sell while the information is being withheld lose a value to which they have an "ownership right." Manne correctly notes that insider trades may capitalize the return without a costly release of information. Hence, most stockholders who sell during the period

[7] "Informed traders" possess private information concerning the future returns of the stock. "Insiders" are often corporate officers and their close relatives. The two groups are not always identical.

[8] Market makers buy and sell securities on demand at publicly quoted prices.

[9] If investors are reasonably aware of the level of informed trading, but do not know which firms experience the most informed trading, then increases in insider trading more generally will have negative externality effects across firms.

before the information release benefit from the project, as they "should."[10] More recently, John and Mishra [1987] provide a model of the interaction of the firm's financing decisions with inside information. They demonstrate that investment announcements and changes in insiders' holdings are joint information signals about firm value, and that the most efficient form of signalling may rely upon insider trading.[11]

Insider trading may also have very little effect on firm value. Private information may be disclosed by the mere fact that there is an attempt to trade, limiting the impact of inside information. There is also the possibility that a firm may be able to design a compensation scheme which minimizes the impact of insider trading. Studies by Harris and Raviv [1979], Holmstrom [1979], Diamond and Verrecchia [1982] and Trueman [1983], amongst others, have characterized the form of an optimal contract when the effort or actions of an agent [the executive] cannot be observed by a principal [stockholders]. This action is generally called "effort," but may be applied to insider trading. Beck and Zorn [1982] construct a model of the ownership share of managers. Their analysis suggests that managers should be induced to own stock, as does empirical work by Masson [1971] and our results here. Corporations often "expect" executives to own substantial amounts of firm stock, and some may "require" they do so (cf. *Wall Street Journal*, April 17, 1990, p. 1).[12] If insider trading is capitalized in stock prices, or if it is restricted to optimal levels by incentive schemes, then stock price data cannot reveal whether unrestricted trading would be harmful. As noted above, our dataset is drawn from a period when there was insufficient past data for stockholders to form reasonable estimates of the model's parameters, so we may detect the influence of insider trading.

With our data we can test arguments in favor of unrestricted insider trading. For such a test it is essential to distinguish between stock ownership by insiders, which provides incentives to maximize firm value, and insider [information] trading which may lower firm value. Our tests are only capable of rejecting a strict form of the Manne hypothesis (i.e. insider trading monotonically raises firm value). The results indicate that even with legal prohibitions for trading on the basis of specific material information, at the

[10] Those who sell to the insider before the stock price is bid up to the true value superficially face a loss to the insider, as they do not receive this true value. But, if they would have sold in any case, they probably would have faced a greater "loss" to some third party without the positive price effects of the insider trading.

[11] The value of the firm is determined exogenously, but efficient signalling, by overcoming problems of adverse selection and asymmetric information, improves efficiency by increasing the ease with which capital can be raised. Scholes [1972], Kraus and Stoll [1972], and Dann, Myers and Raab [1977], amongst others, find existence of a differential price impact for block trades depending on whether the initiator of the trade is an insider or not. (Block trades (10,000 shares or more) are generally negotiated as opposed to the anonymous dealer market for smaller trades.)

[12] If executives believe that greater stock ownership leads to better executive performance in other executives, then those with substantial ownership would tend to promote executives who have greater stock ownership.

observed margin *trading on insider information lowers firm value.* The results also suggest that *executive stock ownership raises firm value.*

II(i). *A model of insider trading and the executive compensation function*

To understand the intuition underlying our empirical model, we present a highly simplified principal-agent model of executive compensation and insider trading.[13] Consider a model of a single firm which is run by executives who possess some inside information concerning the long-term value of the firm. The firm's owners face the problem of structuring executive compensation on observable and verifiable actions or outcomes. As is standard in such problems, we assume that the principal has information about the exact form of all functional relationships (e.g. the form of the executive's utility function), but cannot observe (or verify) some aspects of executive performance. The unobservable we model is whether individual executive stock trades were made on the basis of specific inside information. As is typical of principal-agent problems, the analysis is facilitated by assuming linear additivety.[14]

Suppose that the executive derives utility from income. Income takes two forms. First there are executive earnings from compensation and stock ownership. Second there is income from insider trading.[15] The optimal compensation package can be expressed as a "two-part tariff," a fixed level of compensation plus linear incentive terms. Executive compensation is assumed to consist of: (1) a constant base salary, α_0; (2) a fraction of firm value, $\alpha_1 V$ (where V is defined prior to compensation);[16] and (3) compensation tied to the level of sales, $\alpha_2 s$. Additionally, executives have earnings from stock ownership, where Ω represents the fraction of the firm the executive owns.[17] Let $R(t)$ represent the gross returns from insider trading, where t is an unobservable activity variable corresponding to the level of executive trading based upon private-insider information. Firm value, $V(t, s)$, is assumed to be an additive function of sales, $v(s)$, less the effects from insider trading, $c(t)$, plus a random error term, ε. The random error term we shall assume to have zero mean and, for notational convenience, to be independent of s and t. Note that the "cost" $c(t)$ may be negative, so we have not imposed any *a priori* restrictions on the effect of insider trading on firm value. The executive's utility, $U(t, s)$, is assumed to be linear in income and sales. Indexing the utility

[13] A related model is discussed in Flath and Knoeber [1985].

[14] See Guesnerie and Laffont [1984] for the role of separability in these models.

[15] We separate ownership and trading income. The ownership income can be thought of as income on shares owned for the entire period.

[16] Using gross value simplifies the notation at no loss of generality. If gross value is V, and compensation is C, then $C = \alpha V$ implies $C = \alpha(V-C)/(1-\alpha)$.

[17] We are treating the time period t as if the executive enters with a fixed number of shares, and values them as if they must be sold at the end of the period. Since V is gross value, if $C = \alpha V$ then $\Omega = \Lambda(1-\alpha)$, where Λ is the proportion of stock owned by the executive.

of money as 1 and substituting in the executive's earning function, expected utility can be written as:

$$(1) \qquad E[U(t,s)] = \{\alpha_0 + (\alpha_1 + \Omega)[v(s) - c(t) + \varepsilon] + \alpha_2 s + R(t)\} + \gamma s$$

where we assume that $v_s > 0$ and $v_{ss} < 0$. The coefficient Ω represents the executive's stock ownership, which we take as exogenous.[18] The γ represents the utility of sales to the executive. The "sales maximization hypothesis" would suggest that greater sales would raise executive utility so $\gamma > 0$. Alternatively if sales requires effort which causes disutility, $\gamma < 0$. Taking expectations, with this risk neutral formulation, the ε term can be dropped. In fact, the ε plays no active role in the analysis of the model. If there were no uncertainty, and the Board knew perfectly all functions, and if $c(t)$ were monotonic, then the Board could infer t from knowing s and $V(t, s)$. By adding ε, t cannot be inferred from knowing these values. But formally the ε term drops out of the calculations. Then the executive will maximize [expected] utility by meeting the first order conditions:

$$(2) \qquad U_s = (\alpha_1 + \Omega)v_s + \alpha_2 + \gamma = 0$$

$$(3) \qquad U_t = -(\alpha_1 + \Omega)c_t + R_t = 0$$

Equations (2) and (3) represent the incentive compatibility (IC) constraints faced by the owners. In addition, an individual rationality (IR) constraint assuring the executive of a given level of utility, U^0, must also be satisfied.[19] Finally, we need to add one further constraint to the problem. In problems of this nature without risk aversion, optimal effort may be induced by having the executive pay the owners an amount equal to the full value of the firm at the optimal effort (trading and sales) level, for which in return the executive becomes the residual claimant, receiving all of the profits at whatever level of effort the executive chooses for running the firm. In real world situations, this is seldom practical due to uncertainty, risk aversion and bankruptcy constraints. To keep the model manageable we have eliminated these elements from the problem. To bring back their essential character, we add in a constraint that the executive cannot earn more than some maximum, M, through the sum of personal stock plus compensation where M is a fraction of the full firm value ($\alpha_1 + \Omega \leqslant M < 1$).

[18] This assumption helps considerably in model presentation. But the endogeneity of Ω is important for many related issues. For example, it may be optimal for an out-going *CEO* to promote an executive with larger stock ownership or for the firm to pay in stock options. And important here, any policy that decreases the executive's potential earnings from insider trading may make the size of the executive's optimal portfolio smaller, and especially so if liquidity trading (for cash or portfolio balance) cannot be perfectly distinguished from insider (informed) trading.

[19] IR constraints are common in the principal agent literature. But as noted in Masson [1969, 1971], top executives and firms normally face a "bargaining range" due to firm specific knowledge. Rather than thinking of U_0 as an IR constraint (e.g. if the constraint is not met the executive will exit the firm), it is more useful to think of it as a negotiated level of utility.

Consider the problem faced by the Board of Directors that represents the owners. The solution to the Boards' problem for setting the α_is is solved using the standard principal-agent approach of modeling the Board as setting not only the α_is, but also setting the levels of s and t, but being constrained to do so by the executive's IC and IR constraints. The Board is also assumed to be risk neutral. As before the effect of the uncertainty, ε, plays no formal role in the calculations, so we take expectations before presenting the Board's problem. In Lagrangian form this is

$$\begin{aligned}(4)\qquad \mathscr{L} = {} & \{v(s)-c(t)\}-\{\alpha_0+\alpha_1[v(s)-c(t)]+\alpha_2 s\} \\ & +\lambda_1[(\alpha_1+\Omega)v_s+\alpha_2+\gamma]+\lambda_2[(\alpha_1+\Omega)c_t+R_t]+\lambda_3(M-\alpha_1-\Omega) \\ & +\lambda_4\{[\alpha_0+(\alpha_1+\Omega)[v(s)-c(t)]+\alpha_2 s+R(t)]+\gamma s-U^0\}\end{aligned}$$

The first two terms express net firm value as gross value minus compensation (note the Board as a fiduciary maximizes in the interests of all stock holders including the executive). The first two constraints are IC constraints, the third is the limit on payments to the executive and the fourth constraint is the IR constraint. Each constraint is set up such that its corresponding multiplier is non-negative.

The first order conditions are:

$$(5)\qquad \mathscr{L}_s = (1-\alpha_1)v_s-\alpha_2+\lambda_1(\alpha_1+\Omega)v_{ss}+\lambda_4\{(\alpha_1+\Omega)v_s+\alpha_2+\gamma\} = 0$$

$$(6)\qquad \mathscr{L}_t = -(1-\alpha_1)c_t-\lambda_2\{(\alpha_1+\Omega)c_{tt}+R_{tt}\}+\lambda_4\{-(\alpha_1+\Omega)c_t+R_t\} = 0$$

$$(7)\qquad \mathscr{L}_{\alpha_0} = -1+\lambda_4 = 0$$

$$(8)\qquad \mathscr{L}_{\alpha_1} = -(v(s)-c(t))+\lambda_1 v_s-\lambda_2 c_t-\lambda_3+\lambda_4[v(s)-c(t)] = 0$$

$$(9)\qquad \mathscr{L}_{\alpha_2} = -s+\lambda_1+\lambda_4 s = 0$$

$$(10)\qquad \mathscr{L}_{\lambda_1} = (\alpha_1+\Omega)v_s+\alpha_2+\gamma = 0$$

$$(11)\qquad \mathscr{L}_{\lambda_2} = -(\alpha_1+\Omega)c_t+R_t = 0$$

$$(12)\qquad \mathscr{L}_{\lambda_3} = M-(\alpha_1+\Omega) = 0$$

$$(13)\qquad \mathscr{L}_{\lambda_4} = \{\alpha_0+(\alpha_1+\Omega)[v(s)-c(t)]+\alpha_2 s+R(t)\}+\gamma s-U^0 = 0$$

From these FOCs we can solve for the relevant characterization of the optimal executive compensation and/or earnings functions.

(14) From (7) $\lambda_4 = 1$.

(15) From equations (14) & (9) we obtain $\lambda_1 = 0$.[20]

(16) Finally, (5), (15) & (14) imply
$-(1+\Omega)v_s = \gamma =$ MRS of income for sales.

[20] This implies the solution will satisfy (10), even if (10) is eliminated.

If $\gamma > 0$ (executives derive prestige/utility from sales) then equation (16) implies $v_s < 0$. This means that the executive is optimally paid partly in kind, through permitting some sales expansion beyond the point at which gross firm value is maximized. In terms of the compensation function this would be effectuated by setting the value of α_2 to be negative:

(17) Equations (16), (10) & (12) imply $\alpha_2 = -\gamma(1+\Omega-M)/(1+\Omega) \leqslant 0$.

This means that *at the margin* the executive will optimally be given disincentives for sales expansion if $\gamma > 0$. (If executives obtain no utility from sales then $\alpha_2 = 0$.)

(18) Equation (12) implies that: $\alpha_1 = M-\Omega > 0$.

This means that the degree of reliance of *compensation* upon stock valuation is a declining function of stock ownership. In other words, the only correct methodologies for accurately assessing optimal executive-firm links are ones that look at compensation *conditioned on stock ownership* or ones that look at the executives' *complete earnings* from the firm, including ownership earnings (as in Masson [1971]).

Our primary focus, however, is on the effect of insider trading on firm value. Unlike sales and value that can be measured, and have associated compensation parameters, the results on the unobservable insider trading are only observable through indirect terms based upon their costs and returns.

(19) Equations (12) & (11) imply $c_t = R_t/M$.

Amongst other things, this means that the sign of c_t and R_t are the same, or that *at the margin* executive insider stock trading will, if it has a direct value to the executive, cost the firm money. Further, if executives receive positive value from insider trading (at the margin) those who have more of their earnings based on firm value (greater M) will pursue insider trading to a lesser degree. For example, for the strict Manne hypothesis, that there is a positive value to the firm of insider trading, the model implies that the executives must have negative personal returns from these trades (e.g. due to Securities and Exchange Commission (S.E.C.) enforcement).

The model yields a set of testable hypotheses captured in equations (17), (18) and (19), but these rely on unobservables (M, γ, c_t and R_t) so they cannot be immediately implemented as regressions. We turn to empirically implementing these hypotheses in the next section.

III. AN EMPIRICAL MODEL

An important result is that the incentive effects of compensation cannot be accurately assessed without including stock ownership earnings in the same test. The greater an executive's stock ownership, the lower should be the

compensation reliance on stock value.[21] Further, had we not assumed separability, as stock ownership (plus compensation based upon stock value) varies, then the costs (at the margin) of insider trading will vary (as will the unobserved level of trading). This suggests that, to estimate the effects of insider trading on the value of the firm, the empirical model should treat compensation, ownership and trading issues simultaneously.

The data consists of a detailed sample of thirty-nine firms in three industries– aerospace, chemicals, and electronics for the years 1946–1968. The data is particularly well suited to our analysis because it is unlikely that the effects of insider trading were capitalized in stock prices. The data begins in the late 1940s when a new managerial class faced a new set of markets and constraints brought about by the Second World War as well as the regulatory and ownership changes during the Depression immediately preceding the war. It was not until the 1950s and 60s that investor information services began to make these data readily available to potential investors. In the late 1960s the nation's tax code significantly altered the tradeoff between "capital gains" and "earned income," and this suggests a structural change at that time. As argued elsewhere (Masson [1969, 1971]), it is unlikely that stock prices at the time capitalized these factors, making it possible to detect the marginal influence of insider trading.[22] The estimation procedure consisted of two steps. First firm-specific parameters were derived by using time series regressions for each firm. Then, these time series regressions were used to develop indices for each firm, one specifying how much evidence there was that executives did indeed trade firm stock using insider information, and the other specifying how closely the executive returns function was related (either positively or negatively) to short-term changes which occurred in the firm's performance as measured by value, profits, and sales.[23]

Second, the firm-specific indices were in turn related to long-term firm performance.[24] Throughout the study, we maintained the hypothesis that

[21] A casual examination of the data revealed at least one *CEO* with huge stock holdings and an almost flat salary (a stair stepping upward trend), with the other firm executives receiving highly variable salaries plus stock options.

[22] In particular, the structure of executive compensation structures was fundamentally different from the past. Fewer "owners" ran firms, and following the new income taxes, and differential treatment of capital gains, stock options became a major part of some firms' executives' compensation (35 of our 39 firms used some stock options for at least part of the study period).

[23] Analogous to the effect of sales in the theoretical model, if executives derive utility from shortrun profits, the optimal contract will create marginal disincentives for [shortrun] profit expansion, controlling for firm value.

[24] Over the twenty year period there is executive turn-over and the potential for changes in firm compensation and trading policies. Strictly speaking the maintained hypothesis is that firm policies remain the same over time. We feel that policy changes might lead to noise and insignificance, but not bias the qualitative interpretation of any significant results. This would be true if a firm which pursued policy P_1 for $X\%$ of the period and P_2 for the remainder, performed approximately $X\%$ between the performance of one which used P_1 throughout and one which used P_2 throughout the period.

executive motivations originate executive decisions on investment, pricing, and the like, and that these decisions plus random factors create firm performance. Thus, the correct testing model relates motivational indices to final performance and must exclude intermediate executive choice variables such as investment.

III(i). *Measuring insider trading*

We first need to identify executive trading based on insider information. If executives in one firm purchase stock in their firm before its price increases more consistently than do executives in another, then one may infer that the executives in the former make more (or better) use of insider information than do those in the latter. Following this hypothesis, we derive a measure of executive trading using data from S.E.C. Form 10-*K*.[25] These provide annual figures on year-end stock ownership, stock options granted and exercised (grant price, price at the time of the grant, exercise price, dates and quantities) and stock bonuses. They also provide other compensation data including salary, bonuses (current and deferred), estimated retirement benefits accrued, etc.[26] Firms are required to report these data for a minimum of the top three executives, and often for a greater number of executives. For comparability to those reporting only for three executives, we limited our sample to the top three to five executives.

Since liquidity and stock portfolio adjustments may affect stock trading, they were used as variables to explain executive stock purchases. To capture trading on the basis of knowledge of changes in future stock returns, we used actual future stock returns as explanatory variables as well. Firm-specific indices were established using time series regressions for thirty-nine firms of the form:

$$(20)\qquad \frac{STPUR_t}{STPORT_t} = \alpha_0 + \alpha_1\left[\frac{SAL_t - SAL_{t-1}}{STPORT_t}\right] + \alpha_2\left[\frac{OPTION_t}{STPORT_t}\right] + \alpha_3[STPORT_t] + \sum_{k=1}^{4} \Theta_k R_{kt} + \varepsilon_t$$

where:

$STPUR_t$: is the individual executive's dollar value of net purchase of (own firm) stock in year t,

$STPORT_t$: is the dollar value of the executive's portfolio at the beginning of the year,

[25] This information is generally in the Proxy statement.

[26] Only annual data are readily available for earlier years. These data may miss short term swings in executive stock ownership, but short swings are most highly monitored by the S.E.C.. The S.E.C. mandates monthly reporting of trades and that profits from short term swings must be returned to the firm, without any need to show that inside information was used for those trades. Any missed insider information trades simply makes estimation less efficient.

SAL_t: is *current* after-tax remuneration (dollar value of salary plus bonus in year t),

$OPTION_t$: is stock options granted (valued at current prices) and

$R_{kt}, k = 1,\ldots,4$: are four measures of the return on company stock over the year and a half following the stock purchase. These measures will be explained more fully below.

These regressions were run for all executives and for two sub-groups: those who were within two years of retirement and those who were not.[27] This split was made for several reasons. First, executives nearing retirement might have less fear of being caught and penalized by either the S.E.C. or the firm's Board of Directors. Second, executives nearing retirement would have less to lose from adverse changes in future firm value. Third, executives nearing retirement had typically achieved their maximum ability to affect firm performance. Thus, we would expect this group to be the most likely to trade on the basis of insider information and also the most likely to manipulate firm value to profit from trading.

We used a proportional measure of stock trading as a dependent variable, hypothesizing that the greater the proportion of portfolio an executive trades, the more noticeable the trading is to those who are attempting to detect trading on the basis of insider information.

Net purchases reflect *market* purchases. If a stock option was exercised, an executive who had zero market net purchases would have an expanding stock portfolio, offset by an equal decline in options portfolio. So net market purchases are used rather than changes in holdings. The term showing changes in current remuneration as a proportion of stock portfolio gives a partial measure of changes in executive liquidity. It was hypothesized that increases in this figure would lead to more stock purchases, and this hypothesis was supported at a 98 percent significance level: in 26 of the 39 separate firm regressions the sign on this term was positive.[28]

The current year's stock option *grants* were included to take account of non-market portfolio increases.[29] Ex-post, this figure appears to have had little effect—the sign on this term was positive for 20 of the 35 cases where the

[27] The unit of observation is each executive's stock trading, so more than one trade may be observed in each year.

[28] We do not report all 39 separate firm regressions, but do report a few summary statistics. These are based on the non-parametric "zero test." The null hypothesis is that there is a 0.5 probability of a positive coefficient in each firm regression. The significance test comes from the binomial distribution. Qualitative descriptions of the trading functions were virtually identical for those nearing retirement and those not nearing retirement. For descriptive purposes, we only report the results for the latter group in this section.

[29] An option pricing formula, such as the Black–Scholes formula, might be considered for measuring the value of stock options, but the information to do so is unavailable for this dataset. Measuring the *value* of stock options using current stock prices creates a slight downward bias.

firms used stock options. Finally, the value of the portfolio was included because it seemed likely that larger portfolios would change proportionally less. In fact, the effects of this variable were negative in 24 of 39 regressions, which supports the hypothesis at a 90 percent significance level.

Most important are the terms showing future stock returns. Firms with trading based on insider information should show stock purchases before price (and/or dividend) increases and stock sales before decreases. Four measures of future stock return were used in this study. Each of these measures included a measure of capital gains (at a capital gains tax rate) and dividends (at an earnings tax rate) computed on the basis of each executive's remuneration received within that tax year. The first measure took the return from the mean price of the year t, attributed to the midpoint of the year, to the closing quote in year t. The second measure is the return from the closing quote of year t to the closing quote of year $t+1$. The third and fourth measures cover the same period, but go from the mean return of t to the mean return of $t+1$ and from there to the close of $t+1$. Since $\{R_{1t}, R_{2t}\}$ and $\{R_{3t}, R_{4t}\}$ are two different measures covering the same period we run two tests, one including all four measures and one using only the first two measures.

If the insider trading in period t affects stock returns in period $t+1$, then return in period $t+1$ is correlated with the error term in equation (20) in period t, and ordinary least squares estimates of the regression coefficients will be inconsistent. In actual practice, this bias may be small, and even if the coefficient estimates are subject to some bias, equation (20) is being used only to construct an index of insider trading activity; what matters is an ordinal ranking of the use of insider information.

These regressions were run for a subset of executive years. Following Lorie and Niederhoffer [1968], all years in which an executive exercised a stock option were dropped from the sample.[30] As they point out, an executive should not buy stock in the stock market if the executive expects that stock to perform poorly in the future, but that an executive may exercise stock options to be able to sell the stock before its price declines. Thus, if a firm withholds bad news, its executives may expand their portfolios as they exercise stock options to be able to sell the stock.

If there is trading on insider information, the coefficients on these terms (the R_{it}s) should be positive. If there is no trading on insider information, they should be randomly distributed. Indeed, when we use either nonparametric tests (i.e. the counting of positive and negative signs) or parametric tests (i.e. using standard t-tests), there is no strong evidence of trading on insider information *as a general rule.* However the efficiency tests we use depend upon insider trading *not* being a general phenomenon. Indeed, if insider trading is costly to the firm, one would expect many firms to have significantly

[30] This excludes about ten percent of the executive years in the sample.

reduced it. It is precisely these "low trading" firms we would then expect to drive our test by performing "better."

Once no general pattern can be established it would be naive and incorrect to reject the possibility of *some* insider trading and cease to search further. Statistical tests of this nature can only account for Type I error, not Type II error. If only a small fraction of our firms had significant insider trading, these firms should have positive coefficients, yet the sample as a whole may not look like one dominated by positive coefficients. And as noted above, the ideal would be to only have a fraction of the sample with significant insider trading. So, even though our initial results do not confirm that trading on insider information is prevalent, it is of interest that our index of insider trading is correlated with long-term firm performance in our Efficiency Test.

III(ii). *The efficiency test*

The influence executives' financial interests have on their firm's performance was examined by means of a cross-sectional test. We adopted a two-stage procedure to resolve the difficulties induced by the joint dependence of executive compensation and the effect of insider trading as brought out in the model of section II.

The first step is to derive measures of executive compensation on a company-by-company basis from the estimated earnings function. In what follows, executive earnings are defined as estimates of after-tax present values of accrued earnings.[31] A set of individual firm regressions were run of the form:

$$E_t = \phi_0 + \phi_1 S_t + \phi_2 S_{t-1} + \phi_3 P_t + \phi_4 P_{t-1} + \phi_5 V_t + \phi_6 V_{t-1} \tag{21}$$

where E_t, S_t, P_t, and V_t are respectively the percent change in executive earnings,[32] firm sales, profits, and stock market returns (capital gains plus dividends at imputed tax rates, divided by initial stock price) in the year t. *A priori*, it is expected that $(\phi_1 + \phi_2) \leqslant 0$, $(\phi_3 + \phi_4) \leqslant 0$ and $(\phi_5 + \phi_6) > 0$. These results were generally confirmed and presented in Masson [1971].[33] These were converted to indices for the next stage, the estimation of the effects of insider trading on firm value. We create the indices $\hat{\Phi}_{Si}$, $\hat{\Phi}_{Pi}$, and $\hat{\Phi}_{Vi}$ which are, roughly speaking, the proportional dependence of changes in executive

[31] The earnings estimates consist of after-tax salary plus bonus, plus the after-tax dividends on owned stock, plus accrued capital gains on stock options and owned stock at estimated capital gains tax rates. For deferred compensation accrued, the present value net of taxes was estimated. A current insurance company annuity value was applied to each year's increase in projected retirement benefits net of taxes. Details are in Masson [1969].

[32] The unit of observation was the firm-year. The percent change in earnings for the included executives as a group was taken to the power $2/3^{rds}$.

[33] The first two weak inequalities are measured as negative in 21 and 23 of cases, respectively. These are insignificantly negative. The third inequality, which is predicted to be a strict inequality, is positive for 30/39 trials, leading to 99% significance.

returns on sales performance, profits (earnings per share) performance, and stock market performance. For each firm these indices are defined by:

$$\hat{\Phi}_S = \frac{\hat{\phi}_1 + \hat{\phi}_2}{|\hat{\phi}_1 + \hat{\phi}_2| + |\hat{\phi}_3 + \hat{\phi}_4| + |\hat{\phi}_5 + \hat{\phi}_6|} \tag{22}$$

$$\hat{\Phi}_P = \frac{\hat{\phi}_3 + \hat{\phi}_4}{|\hat{\phi}_1 + \hat{\phi}_2| + |\hat{\phi}_3 + \hat{\phi}_4| + |\hat{\phi}_5 + \hat{\phi}_6|} \tag{23}$$

$$\hat{\Phi}_V = \frac{\hat{\phi}_5 + \hat{\phi}_6}{|\hat{\phi}_1 + \hat{\phi}_2| + |\hat{\phi}_3 + \hat{\phi}_4| + |\hat{\phi}_5 + \hat{\phi}_6|} \tag{24}$$

Of course, since some of the ϕ_is are negative, these measures are only analogous to proportions.

The second step is to construct a measure of long-term firm performance using stock market returns data.[34]

The form of the estimating equation used to test these influences on company performance is:[35]

$$PSTR_i = \gamma_0 + \gamma_1 \hat{\Phi}_{Si} + \gamma_2 \hat{\Phi}_{Pi} + \gamma_3 \hat{\Phi}_{Vi} + \gamma_4 SC_i + \gamma_5 D_{1i} + \gamma_6 D_{2i} + \gamma_7 \hat{\Theta}_{1i} + \gamma_8 \hat{\Theta}_{2i} + \gamma_9 \hat{\Theta}_{3i} + \gamma_{10} \hat{\Theta}_{4i} + \varepsilon_i \tag{25}$$

where:

$PSTR_i$: is the measure of the i^{th} firm's long term stock performance,
$\hat{\Phi}_{Ji}$s: $J = \{S, P, V\}$ are the parameters of the executive earnings functions, equations (22)–(24) above,
SC_i: is firm scale (average sales) in 1947–50,
D_{ji}s: are industry dummy variables,
$\hat{\Phi}_{ki}$: are parameter estimates from the insider trading equation (20) above (in some cases only two $\hat{\Phi}_{ki}$s were used).

The variable $PSTR_i$ represents the i^{th} firm's postwar stock return performance—it is a normalized measure of unanticipated increases in the firm's present value. That is, it is the present value of dividends plus capital gains (each at their imputed tax rates) from the purchase of a number of shares, one-third of which were purchased in each of the years 1948, 1949, and 1950; were similarly sold in thirds in 1963, 1964, and 1965; and discounted by 6 percent, taken as a proportion of initial investment. This variable measures the value of earnings to an individual who invests at an average 6 percent interest rate—a rate between the [historical] bond rate and the return on stocks—if the individual reinvests dividends in an average portfolio.

[34] Variability of return is in part endogenous by hypothesis. To account for exogenous industry variability we use industry dummies.

[35] The endogeneity issue of having a performance measure as a dependent variable in equation (25) and other performance measures as independent variables in (20) and (21) is addressed in the Appendix.

The variables $\hat{\Phi}_V$, $\hat{\Phi}_S$ and $\hat{\Phi}_P$ are as defined above in (22)–(24). The hypothesis is that financial incentives based on stock market performance should be effective in improving firm performance. Given the multicollinearity between these variables, an appropriate test is whether $\hat{\gamma}_3 > \hat{\gamma}_1 + \hat{\gamma}_2$ (where $\hat{}$ denotes parameter estimates).[36] In other words, as the present value of the firm becomes more important in determining executive returns, and short-term sales and profits become less important or even negative, the firm will perform better in the long run.

The variables $\hat{\Theta}_{1i} - \hat{\Theta}_{4i}$ in equation (25) are indices of the degree of executive insider trading. They are the estimates of the parameters, Θ_{ki} in equation (20) ($k = 1, \ldots, 4$). $\hat{\Theta}_{1i}$ represents the trading response in anticipation of increases in stock earnings from the mean of the test year to the close of the year. $\hat{\Theta}_{2i}$ is the response based on the close of that year to the close of the next year. $\hat{\Theta}_{3i}$ and $\hat{\Theta}_{4i}$ are based on the same time period but are measured from this year's mean to the next year's mean and from then to its close. If there are costs to the firm at the margin in allowing unrestrained insider trading, then these variables should have a negative influence on the firm's performance. This hypothesis is tested by examining hypotheses $\hat{\gamma}_7 + \hat{\gamma}_8 + \hat{\gamma}_9 + \hat{\gamma}_{10} < 0$ (or $\hat{\gamma}_7 + \hat{\gamma}_8 < 0$ when only $\hat{\Theta}_1$ and $\hat{\Theta}_2$ are used in the regression).

The scale variable adjusts for initial scale in case the market favored some sizes of firms in an unanticipated fashion later, possibly due to structural changes in the capital market's evaluation of uncertainty or the effects of changing antitrust policies towards market leaders. The dummy variables account for unanticipated demand (or cost) shifts that affected one of the industries differently from the others, and to adjust for differences in risk characteristics among the industries. Since the test examines unanticipated firm performance, which may be attributed to the motivations and actions of the firm's executives, without the dummy variables an unanticipated demand shift that raises or lowers the performance of one industry would have been attributed to whatever executive characteristics prevailed in that industry.

III(iii). *Empirical results*

The results of this study support the hypothesis that executive stock trading has a cost to the firm. Before turning to these results, we briefly consider the "control variables" based upon executive compensation structures. These are unchanged from those in Masson [1969, 1971].

The tests here are presented in the second from the last row in Table I.

[36] The intuition can be grasped if we think of (22)–(24), having eliminated the absolute values on the term $(\hat{\phi}_5 + \hat{\phi}_6)$ in each denominator. If we were to then take the derivative of *PSTR* (equation 25) with respect to $(\hat{\phi}_5 + \hat{\phi}_6)$, we would find that the effect of value based compensation on long term performance depends upon the differences between γ_3 and both γ_1 and γ_2.

TABLE I
MOTIVATIONS AND FIRM STOCK MARKET VALUE†

Variable	Coefficient	*A* Executives Near Retirement	*B* Executives Near Retirement	*C* Executives Not Near Retirement	*D* Executives Not Near Retirement	*E* All Executives	*F* All Executives
Const	$\hat{\gamma}_0$	1.66	1.34	1.20	1.28	1.34	1.40
		(1.92)**	(1.53)*	(1.31)*	(1.46)*	(1.51)*	(1.60)*
$\hat{\Phi}_S$	$\hat{\gamma}_1$	−0.72	−1.29	−1.15	−1.27	−1.30	−1.35
		(0.54)	(0.96)	(0.87)	(0.99)	(0.97)	(1.02)
$\hat{\Phi}_P$	$\hat{\gamma}_2$	−1.88	−1.65	−1.67	−1.64	−1.67	−1.63
		(1.81)**	(1.60)*	(1.51)*	(1.62)*	(1.57)*	(1.57)*
$\hat{\Phi}_V$	$\hat{\gamma}_3$	+0.47	+0.34	+0.51	+0.51	+0.08	+0.23
		(0.36)	(0.25)	(0.36)	(0.37)	(0.06)	(0.17)
SC	$\hat{\gamma}_4$	−0.003	−0.002	−0.002	−0.002	−0.002	−0.002
		(0.83)	(0.61)	(0.51)	(0.55)	(0.39)	(0.52)
D_1	$\hat{\gamma}_5$	+1.34	+1.61	+2.01	+1.89	+1.53	+1.51
		(1.27)	(1.50)*	(1.75)**	(1.75)**	(1.43)*	(1.42)*
D_2	$\hat{\gamma}_6$	+0.24	+0.59	+0.28	+0.16	−0.30	−0.18
		(0.19)	(0.45)	(0.21)	(0.13)	(0.24)	(0.15)
$\hat{\Theta}_1$	$\hat{\gamma}_7$	−0.42	−0.23	−1.13	−0.97	−1.24	−0.77
		(2.36)**	(1.59)*	(1.65)*	(1.68)*	(1.80)**	(1.44)*
$\hat{\Theta}_2$	$\hat{\gamma}_8$	−0.56	−0.13	−0.72	−0.56	−1.05	−0.42
		(2.51)**	(1.60)*	(1.11)	(1.73)**	(1.49)*	(1.49)*
$\hat{\Theta}_3$	$\hat{\gamma}_9$	−0.35	n.a.	+0.13	n.a.	−0.07	n.a.
		(1.58)*		(0.22)		(0.09)	
$\hat{\Theta}_4$	$\hat{\gamma}_{10}$	−0.70	n.a.	−0.14	n.a.	−0.73	n.a.
		(1.99)**		(0.18)		(0.84)	
R^2		0.39	0.29	0.32	0.30	0.33	0.29
t-value	$\hat{\gamma}_3 > \hat{\gamma}_1 + \hat{\gamma}_2$	1.56*	1.66*	1.83**	1.80**	1.42*	1.56*
t-value‡	$\sum_{i=7}^{n} \hat{\gamma}_i < 0$	2.46**	1.60*	0.80	1.70**	1.08	1.46*

† One asterisk is for one-tail t that is significant at 90% ($t \geq 1.31$), two asterisks for significance at 95% ($t \geq 1.70$), and three asterisks for significance at 99% ($t \geq 2.46$).
‡ n is equal to seven plus the number of independent variables included in the regression minus one.

Executive earnings structures which, at the margin, emphasize stock returns and de-emphasize, *ceteris paribus*, sales performance and short-run profits performance, lead in the long run to better firm performance. The hypothesis $\hat{\gamma}_3 > \hat{\gamma}_1 + \hat{\gamma}_2$ is significant at the 95 or 90 percent level in each of the tests, and supports this conclusion.

So we can turn to our primary focus: Insider Trading. There were six tests of the hypothesis that insider trading imposes costs on the firm, and these are presented in the last row of Table I. First there are two (not independent) tests based upon executives who were near retirement. In Table I, test *A* tests this hypothesis using all four insider trading variables. This test yields a t-value of 2.46, which is significant at the 99 percent level. Test *B* performs the same test using only two indices. Here the t-value falls to 1.60, and is only significant at the 90 percent level.

An independent set of tests was performed using a different sample of

executives, those not nearing retirement. From these the results were somewhat weaker. Although test *C* has the right sign, it is not significant, whereas test *D* has the correct sign and is significant at the 95 percent level. The results for the pooled sample of all executives, whether or not they were nearing retirement, are presented in tests *E* and *F*. They are weaker than the results presented for the subgroups, yet they retain the expected properties.

Tests *A* and *B* capture our strongest prior belief, that executives near retirement would be most likely to use insider information for their stock trading, even if this had a cost to the firm [*holding returns from stock and compensation constant*]. Of course, given our priors, executives not nearing retirement should also injure firm value by trading on insider information. Keeping in mind that this set of executives provides an independent test of the same generic hypothesis, its similar (but somewhat weaker) results bolster the results in tests *A* and *B*. Given the problem of errors in variables associated with the use of these estimated indices, the results may be accepted unless there are *a priori* reasons to expect the estimating error to be correlated with the dependent variable—and no such strong *a priori* reason is apparent.

The sum total of these results leads us to reject the "Strict Manne Hypothesis," that all insider trading enhances firm value. Since all results are defined at the observed margin, we cannot differentiate between the "Weak Manne Hypothesis," that insider trading only hurts the firm at the margin, and the "Counter Manne Hypothesis," that insider trading injures the firm.[37]

Some care must be taken in generalizing these results. These tests were undertaken for thirty-nine firms in only three industries. Although the structure of executive earnings in these industries is probably similar to that in many other manufacturing industries (contrast Masson [1971] with Lewellen [1969, 1971]), the criterion used for selecting these industries may make them atypical when it comes to considering insider trading. Chemicals, electronics, and aerospace firms have had numerous technological breakthroughs and often bid for large contracts. These may make the gains from insider trading larger, and the public release of information more important to delay. Nevertheless, demonstrating the costs of insider trading in these industries suggests that they may exist in other industries as well.

IV. IMPLICATIONS AND CONCLUSIONS

Our results suggest that insider trading is injurious to firm value. But our results also suggest that firms where executives' stockholdings are significant will tend to perform more efficiently. Given these two factors, it is hard to predict if stiffer or weaker enforcement of current insider trading laws would increase efficiency. The problem for policy makers is that insiders may be

[37] If we knew that a substantial fraction of sample firms had no insider trading than the observed margin would be in the zone of no trading. One could then infer support for the Counter Manne Hypothesis.

unwilling to take large positions in their firms if their trading is restricted or is subject to close scrutiny. In this case, the net effect on firm value is ambiguous. Policies designed to reduce costly insider trading may have a detrimental effect on firm value if executives significantly reduce their holdings of their company's stock. Current regulations require disclosure and tend to discourage insider trading.

Without providing a direct test, these results suggest one policy to consider. A policy that establishes a lower capital gains tax on the stocks an employee holds in his or her firm, subject to a longer holding period to be eligible for the favored treatment, seems to be worthy of attention. The incentives implied by our examination of top executives might also have a significant effect when filtering through to middle management on down. Even employees who do not have significant policy discretion have significant discretion regarding knowledge of shirking by co-workers.

At a broader level the question arises as to whether external policing by a regulatory authority such as the S.E.C. is even necessary. The optimal level of insider trading may vary from firm to firm or industry to industry.[38] Imposing a uniform standard may induce inefficiency, and it may be argued that the policing of insider trading is best left to the firm in question. The owners of the firm can create incentives for executives to hold stock. However, when executives trade their firm's stock, they inherently possess superior information so that promoting *ownership* promotes at least one form of *insider trading*.[39]

Although our results need verification through other types of analysis, covering other methodologies, industries and time periods, they suggest that there may be costs to insider trading. Whether these are best met by current policy, or other policy alternatives, is a larger question.

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[38] Consider for example the model of John and Mishra [1987] where efficient (low cost) signalling relies upon the trades of insiders.

[39] This fits well with Manne's equity arguments, which are easier to rationalize if we refer to stock purchases rather than sales.

APPENDIX

Although a measure of firm value is an independent variable in the earnings and trading equations and another measure of firm value is used a dependent variable in the performance equation, this model does not suffer from the usual simultaneity problem. The dependent variable in the earnings and trading equations is not found in the performance equation. The model formally has a recursive nature and can be analyzed by examining its error structure.

To explain, let us simplify to only a set of earnings equations as functions of only sales and value, and a performance equation. As predetermined variables, the Board of Directors of each of the n firms set a_0^i, a_1^i, and a_2^i, which will remain constant over time. These are the parameters of the earnings relationship such that:

$$\text{(A1)} \qquad E_t^i = a_0^i + a_1^i S_t^i + a_t^i V_t^i$$

where E, S, and V are changes in earnings, sales and value. There are n such independent separate relationships, hence $i = 1, \ldots, n$. The parameters a_0^i, a_1^i, and a_2^i are fixed and S and V are actual realized performances. Since executive decisions involve risk and the Board is less able to evaluate the risks than are the executives, the Board sets earnings as a function of actually realized values for S and V. Hence, for this relationship, S and V are measured without error. Measurement error does exist in E through non-reported perquisites, problems assigning values to deferred compensation and stock options, etc. Hence n regressions of the form of (A1) plus an error term, e_t^i, will give unbiased estimates of the a_j^is regardless of what process is used to generate Ss and Vs by executive decisions along with random factors in a risky world.

This point needs to be stressed. The V (and S) terms in this relationship are assumed to be measured without error. The executives are not paid as a function of the unobservable expected value which would arise from their decisions. For incentive compatibility they must be paid by the decisions' actual observable (and verifiable) outcomes. In this fashion, the Board of Directors assure themselves of appropriate incentives without having to know the density functions which relate executive decisions (e.g. on capital investment) to firm performance. Hence the n regressions are identified for least-squares estimates regardless of the process by which S and V are generated.

For any firm-executive year, decisions are made by the executives who know the probability distributions of S and V conditional on their decisions. They maximize utility given this set of probability distributions and the predetermined variables a_0^i, a_1^i, and a_2^i.

Thus, for any individual year in firm i:

$$\text{(A2)} \qquad V_t^i = b_0 + b_1 a_1^i + b_2 a_2^i + b_3 X_{t-1}^i + \varepsilon_t^i$$

Here the variable X_{t-1}^i denotes initial conditions which may effect the density function. The industry identification may play such a role. The error term reflects the random factors which arise in actual firm value given any set of decisions. A non-stochastic relationship is assumed with respect to the expected value of V_t^i chosen by the executives. Hence, $E[\varepsilon_t^i] = 0$ and the b_is reflect the influence of the predetermined variables on expected firm performance.

The a_j^is are assumed to be fixed over the time period $t = 1, \ldots, T$. Thus, if $V^i \equiv \sum_{t=1}^{T} V_t^i$, and similarly for $\sum_t X_{t-1}^i$ and $\sum_t \varepsilon_t^i$, then:

$$\text{(A3)} \qquad V^i = \beta_0 + \beta_1 a_1^i + \beta_2 a_2^i + \beta_3 X^i + \varepsilon^i$$

where

$$\beta_1 = b_1 T \quad \text{and} \quad \beta_2 = b_2 T.$$

We then collapse the feedback effects between performance and initial conditions over each successive year from the first year forward. The error term $\sum_{t=1}^{T} \varepsilon_t^i$ can be written as η^i and defining $T^{V^i} = \Sigma V^i$, then:

$$\text{(A4)} \qquad T^{V^i} = \beta_0 + \beta_1 a_1^i + \beta_2 a_2^i + \beta_3 X_0^i + \eta^i$$

can be estimated using the $i = 1, \ldots, n$ observations across firms. The error term η^i satisfied the zero mean and normality conditions, and $\text{corr}[a_j^i, \eta^i] = 0$.

Problems arise because the a_j^is are not known with certainty. In place of the true a_j^is we must use the estimates $\hat{a}_j^i$, $j = 1, 2$. The remaining question is whether errors in measurement of the $\hat{a}_j^i$s are correlated with the η^is. That the correlation between the e_t^i and ε_t^i terms is zero follows from the assumptions: e_t^i is the measurement error of earnings, E_t^i; ε_t^i reflects random factors in investment outcomes. There remains an errors-in-variables problem due to the use of the predicted a_j^is from a regression of the form of (A1) (including an error term) rather than true a_j^is of equation (A1) when forming the test used in equation (A4). Measurement error in these terms is correlated with the variance of the e_t^is, but is not correlated with the e_t^is, so no simultaneity problem *per se* arises from this.

In conceptualizing the simultaneity problem, it is important to realize that a high coefficient on a_2^i could be generated due to sharply declining E_t^i with declining V_t^i, or sharply rising E_t^i with rising V_t^i. Hence, a high value of a_2^i in no way prejudges the sign of V_t^i. Similar logic applies to the trading equations as well.

REFERENCES

ABOWD, J., 1990, 'Does Performance Based Compensation Affect Corporate Performance?' *Industrial and Labor Relations Review*, 43, pp. 52S–73S.

ANTLE, R. and SMITH, A., 1986, 'An Empirical Investigation of the Relative Performance Evaluation of Corporate Executives', *Journal of Accounting Research*, 24, pp. 1–39.

BECK, P. J. and ZORN, T. S., 1982, 'Managerial Incentives in a Stock Market Economy', *Journal of Finance*, 37, pp. 1151–1167.

DANN, L., MAYERS, D. and RAAB JR., R., 1977, 'Trading Rules, Large Blocks, and the Speed of Adjustment', *Journal of Financial Economics*, 4, pp. 3–22.

DIAMOND, D. and VERRECCHIA, R., 1982, 'Optimal Managerial Contracts and Equilibrium Security Prices', *Journal of Finance*, 37, pp. 275–288.

FINNERTY, J. E., 1976a, 'Insiders and Market Efficiency', *Journal of Finance*, 31, pp. 1141–1148.

FINNERTY, J. E., 1976b, 'Insider's Activity and Inside Information: A Multi-variate Analysis', *Journal of Financial and Quantitative Analysis*, 11, pp. 205–215.

FLATH, D. and KNOEBER, C. R., 1985, 'Managerial Shareholding', *Journal of Industrial Economics*, 34, pp. 93–99.

GIVOLY, and PALMON, D., 1985, 'Insider Trading and the Exploitation of Inside Information: Some Empirical Evidence', *Journal of Business*, 58, pp. 69–87.

GLOSTEN, L. and MILGROM, P., 1985, 'Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Agents', *Journal of Financial Economics*, 14, pp. 71–100.

GRINBLATT, M., 1987, 'On the Regulation of Insider Trading', Working paper, University of California, Los Angeles.

GUESNERIE, R. and LAFFONT, J.-J., 1984, 'A Complete Solution to a Class of Principal-Agent Problems with an Application to the Control of a Self-Managed Firm', *Journal of Public Economics*, 25, pp. 329–369.

HARRIS, M. and RAVIV, A., 1979, 'Optimal Incentive Contracts with Imperfect Information', *Journal of Economic Theory*, 20, pp. 231–259.

HOLMSTROM, B., 1979, 'Moral Hazard and Observability', *Bell Journal of Economics*, 10, pp. 74–91.

JAFFE, J. F., 1974a, 'The Effect of Regulation Changes on Insider Trading', *Bell Journal of Economics and Management Science*, 5, pp. 93–121.

JAFFE, J. F., 1974b, 'Special Information and Insider Trading', *Journal of Business*, 47, pp. 410–428.

JOHN, K. and MISHRA, B., 1987, 'Investment Announcements, Insider Trading and Market Response: Theory', Working paper, New York University.

KRAUS, A. and STOLL, H. R., 1972, 'Price Impacts of Block Trading', *Journal of Finance*, 27, pp. 569–588.

LEWELLEN, W. G., 1969, 'Management and Ownership in the Large Firm', *Journal of Finance*, 24, pp. 299–322.

LEWELLEN, W. G., 1971, *The Ownership Income of Management*, National Bureau of Economic Research: New York.

LORIE, J. H. and NIEDERHOFFER, V., 1968, 'Predictive and Statistical Properties of Insider Trading', *Journal of Law and Economics*, 11, pp. 35–51.

MANNE, H., 1966, *Insider Trading and the Stock Market*, Glencoe, Illinois: Free Press.

MANOVE, M., 1989, 'The Harm from Insider Trading and Informed Speculation', *Quarterly Journal of Economics*, 104, pp. 823–845.

MASSON, R. T., 1969, 'Executive Compensation and Firm Performance', Ph.D. Dissertation, University of California, Berkeley.

MASSON, R. T., 1971, 'Executive Motivations, Earnings, and Consequent Equity Performance', *Journal of Political Economy*, 79, pp. 1278–1292.

NERLOVE, M., 1968, 'Factors Affecting Differences Among Rates of Return on Investments in Individual Common Stocks', *Review of Economics and Statistics*, 50, pp. 312–331.

PRATT, S. P. and DEVERE, C. W., 1970, 'Relationship between Insider Training and Rates of Return for Common Stocks, 1960–1966', in LORIE, J. and BREALEY, R. (eds.), *Modern Development in Investment Management* (Praeger, New York).

ROZEFF, M. and ZAMAN, M., 1988, 'Market Efficiency and Insider Trading: New Evidence', *Journal of Business*, 61, pp. 25–44.

SCHOLES, M., 1972, 'The Market for Securities: Substitution v. Price Pressure and the Effects of Information on Share Price', *Journal of Business*, 45, pp. 179–211.

SEYHUN, H. N., 1986, 'Insider' Profits, Cost of Trading, and Market Efficiency', *Journal of Financial Economics*, 16, pp. 189–212.

SEYHUN, H. N., 1988, 'The Information Content of Aggregate Insider Trading', *Journal of Business*, 61, pp. 1–24.

TRUEMAN, B., 1983, 'Motivating Management to Reveal Insider Information', *Journal of Finance*, 38, pp. 1253–1269.