PRE-ANNOUNCEMENT OF INSIDERS' TRADES†

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We consider the implications of a regime change regarding the timing of reports of trades made by corporate insiders. Presently, insiders report their trades after the fact; however, recently there have been renewed calls for insiders to pre-announce their trades to curb insiders' ability to profit from their information advantage. Pre-announcement by insiders removes noise trades as source of disguise, implying that insiders can no longer realize such profit. Of course, insiders also trade for other unobservable motives. This too is a source of disguise, but a dysfunctional one because it serves as an incentive to distort trades from those that would be optimal otherwise. As a consequence, insiders may be predisposed to favor accounting standards that expand public disclosures pertaining to firm value. A mitigating factor is the price risk caused by disclosures made in advance of trade. These phenomena are present even without pre-announcement and become more prominent as markets become thinner.

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1. Introduction

Recent corporate scandals have led to renewed interest in revising insider trading regulations so as to promote greater transparency of insider trades. In 2000, the Securities and Exchange Commission (SEC) adopted Regulation FD calling for wide public disclosure of new information and simultaneously afforded insiders an affirmative defense against alleged violations of insider trading rules in advance of such disclosure through pre-arranged trading commitments. In 2002, the SEC adopted amendments to implement a provision of the Sarbanes-Oxley Act shortening the time before insiders are required to report their trades from as long as six weeks to just two days in most cases. In 2003, a blue-ribbon commission on Public Trust and Private Enterprise, recommended that corporate executives be required to provide advance public notice of their intention to sell shares in their companies.[1] These moves toward greater transparency echo much earlier proposals in the legal press, law reviews, and even in the U.S. Congress for pre-announcement of insider trades.[2] As well, some companies require that insiders pre-announce all their trades (e.g., Ameritrade Holding Company) while others require all insider trades take place via pre-arranged trading commitments (e.g., Libbey, Inc.).

In this paper we consider the consequences of a shift from the current regime under which insiders report their trades after the fact (without pre-announcement) to one in which they report their trades before the fact (with pre-announcement). The novelty in our analysis lies in modeling other motives for insiders to trade besides exploitation of private information. Corporate officers, directors, and other insiders routinely trade to realize stock-based compensation, shed firm-specific risk, meet liquidity needs, manage taxes, acquire influence over firm affairs,[3] and plan their estates (see Appendix A for anecdotal illustrations). The presence of these other motives for trading along with the plausible assumption that market makers cannot fully disentangle such motives

[1] In U.S. v. O'Hagan, 117 S. Ct. 2199, the Supreme Court indicated that advance revelation of intent to trade could hypothetically have the ancillary effect of eliminating legal jeopardy.

[2] These include proposals made in the legal press by Klein (1983), in the U.S. Congress by Senator John Chafee (see Committee on Federal Regulation of Securities, 1987), and in law reviews by Gilson and Kraakman (1984), Samuelson (1988), and Fried (1998, 2000).

[3] See Stulz (1988) on benefits of control.

from attempts to profit from private information adds an important dimension to our understanding of how a regulation requiring pre-announcement is likely to affect insiders' trading strategies and price formation. Of special interest to accountants is the likely impact of pre-announcement of trades on insiders' tendencies to oppose public disclosure standards that might pre-empt their information advantage.[4]

Our key findings are that pre-annoucement of trades increases trading costs for and reduces risk shedding by insiders, causing them a loss of expected utility. To avoid this loss, insiders may be willing to support accounting standards that expand pre-emptive public disclosures, but this willingness is mitigated by the price risk caused by the disclosures.

Though insiders trade for many non-information based motives not observable to market makers, for modeling purposes, we focus on one stylized motive, namely, to shed risk associated with a privately observed endowment shock. The endowment shock can be likened to the evolution over time of an insider's exposure to the risk from firm stock price fluctuations. Under current rules governing reporting of insider trades and stockholdings, it is generally not possible to measure precisely either the level or change in this exposure over time from public filings.[5] Even with pre-announcement, an

[4] Evidence of such opposition can be found in Dechow, Hutton, and Sloan (1996) regarding letters pertaining to stock options disclosures, Aboody and Lev (1998) regarding the Software Publishers' Associations negative stance on capitalizing software, and Hughes, Kao, and Williams (2002) regarding the Treasury Management Associations efforts to discourage disclosure of forward contracts. Of course, there could be other reasons for lobbying against standards that advance disclosure unrelated to insiders trading on private account. Standards that mandate more timely disclosure also serve to pre-empt insiders' information advantage. For instance, SEC Proposed Rule "Additional Form 8-K Disclosure Requirements and Acceleration of Filing Date" (Release No. 33-8106 <http://www.sec.gov/rules/proposed/33-8106.htm> accessed June 28, 2004) would require a company to file Form 8-K for 11 new items; move two disclosure items currently required to be included in companies' annual and quarterly reports to Form 8-K; and shorten the filing deadline for Form 8-K to two business days after an event triggering the form's disclosure requirements. Anecdotal evidence of opposition to this proposal for more timely disclosure includes the comment letter dated August 26, 2002 from Frank H. Brod Chair, Committee on Corporate Reporting and David H. Sidwell Chair, SEC Subcommittee of the Committee on Corporate Reporting Financial Executives International to Mr. Jonathan G. Katz, Secretary of the SEC.

[5] Over time, the SEC has changed the section 16(a) reporting requirements to enlarge the set of reportable transactions and to increase the detail in the reports. Under current Rule 16a-3, insiders must report initial stock holdings on Form 3, changes in holdings on Form 4, and year-end holdings on Form 5. The Rule exempts, among other transactions issuer contributions to tax-qualified pension plans. These omissions necessarily introduce error in estimates of exposure to price fluctuations. Further, a complete accounting of an insider's exposure to risk would include anticipated future compensation, which obviously is difficult to measure and is not part of the reporting regime, and details on the other elements of the insider's personal portfolio that covary with firm stock.

insider's incentives for trading are not likely to be known to the market maker since the market maker is not privy to the insider's entire portfolio or changes in firm holdings from non-market transactions. A useful way to think about this structure is to view the model as a reduced form of a larger portfolio-rebalancing problem. Although not presented here, we have also modeled additional motives for trading including both a marginal benefit per share to an insider's ending position and implicit risk sharing and derived qualitatively similar results.[6] The crucial aspect in terms of the underlying economic intuition is the presence of some imprecision in the inferences about insiders' motives for trading that market makers are able to draw from the public record of changes in insiders' holdings, public disclosures by their firms, order flow inclusive of noise trades, and where applicable pre-announcement of insiders' trades. As long as there is some imprecision in market makers imputation of motives, then there will be a tension between the desires to shed risk on one hand and to exploit private information on the other.

Apart from the revelation of insiders' trades, the key distinction between regimes with and without pre-announcement of insider trades is the presence of liquidity trading in the order flow observed by the market maker under the latter regime. Given that liquidity trades constitute a source of noise they serve as disguise for insiders trades. It is well known that the lower the noise from liquidity trading, the lower the gains to insiders from trading on their private information. The regime with pre-announcement can be viewed as the limiting case of no liquidity trading. Holding constant the precision of public disclosures, we show that with pre-announcement of their trades, insiders are no longer able to generate expected profits from their information advantage possible without pre-announcement. That is to say, insiders now bear the trading costs implied by price adjustments made by the market maker in anticipation that insiders may be trading on private information. Constructively, the incentive to distort their trades away from those that would be optimal in meeting other motives (shedding risk in

[6] Modeling incentives for trade as random variables can be traced to Garman (1976) who also assumes that stock ownership conveys private benefits.

our model) in the fruitless attempt to exploit their private information under pre-announcement is a deadweight loss to insiders, a loss that they would prefer to avoid, possibly to the point of removing that incentive by pre-commitment to greater public disclosure so as to reduce their information advantage. While it is the case that pre-announcement of trades reduces the insider's disguise for information based trading, it does not completely remove disguise since the insider has non-information based incentives to trade. However, this disguise becomes harmful rather than helpful to the insider because it results in trading costs imposed on trading his endowment.

The mitigating factor with respect to making pre-commitments to more informative public signals prior to trade under pre-announcement is the added risk of unfavorable price changes when prices adjust to the information conveyed by those signals before insiders trade, as opposed to the lesser information conveyed by the order flow. Hirshleifer's (1971) insight that public disclosure in advance of an opportunity to trade (insure) imposes a deadweight loss is clearly an element of this tradeoff. The tension between the added price risk of disclosure versus the risk of retaining an under-diversified position in a fruitless effort to exploit private information is both subtle and interesting. The tendency to distort trades in a manner that exposes insiders to risk in order to exploit private information is also present without pre-announcement, although in this case the insider's expected profits from conditioning trades on private information may more than offset the deadweight loss from not satisfying other motives; e.g., loss of expected utility due to under-diversification. Among our results with pre-announcement, we depict the tradeoff between the greater price risk from pre-emptive public disclosure than from the order flow and risks from under-diversification implied by trade distortions by demonstrating how an insider's ex ante expected utility changes as a function of the precision of a public signal.

Comparing regimes with and without pre-announcement, it is clear that, by providing insiders with an opportunity to profit from their private information at the expense of noise traders assumed to trade for liquidity reasons, insiders prefer the latter. More

notably, we show that, *ceteris paribus*, insiders prefer accounting standards that go further in the direction of pre-empting their information advantage by mandating greater public disclosure under the former regime than under the latter. This raises the prospect that a new insider trading regulation requiring that insiders pre-announce their trades might mitigate the tendency corporate insiders have exhibited in the past to oppose accounting standards that would expand disclosure. While other reasons for such opposition grounded in sound economic arguments have been offered,[7] it is still the case that holding total information constant pre-announcement removes the opportunity to profit on private information and, hence, is likely to work in the direction of less resistance. Interestingly, we also show that insiders may prefer an interior choice of public signal precision even without pre-announcement provided the amount of noise from liquidity trading is sufficiently small, though not surprisingly the optimal point from the insiders point of view is for less precision without pre-announcement.

A related paper by Glosten (1989) considers a setting in which market makers recognize that they are trading with insiders who may or may not be trading on private information. His interest is quite different from ours in that he seeks to compare the behavior of monopolist market makers (specialists), who provide liquidity by averaging profits over successive trades, with that of competitive market makers, who may more frequently shut down the market when adverse selection problems become too severe. Market shutdowns can occur in our model under pre-announcement of insider trades when there is too little uncertainty regarding the insider's non-information based motive for trading, a case ruled out in our analysis by imposing a second-order condition. Bhattacharya and Speigel (1991) also characterize market shut downs in cases where the adverse selection problem is sufficient to overcome uninformed traders' desire to shed risk. Risk sharing is likewise present in Speigel and Subrahmanyam (1992) as the incentive for uninformed traders to trade with privately informed traders, thereby allowing for trade even in the absence of liquidity trading as in our pre-announcement

[7] For example, public disclosure may reveal proprietary information that would benefit rivals in oligopoly competition.

case. However, none of these papers consider the consequences of greater transparency of insiders' trades on their trading behavior in meeting other motives for trading, level of price risks that insiders may face, and insiders' preferences toward the precision of pre-emptive public signals.

The remainder of this paper is organized as follows: section 2 presents our model; section 3 characterizes equilibria with and without pre-announcement of insiders' trades; section 4 provides comparative statics; section 5 presents sensitivity analysis on the insiders' welfare including the impact of a regime change to require pre-announcement; and section 6 concludes.

2. Model

Similar to a single-period version of Kyle (1985), we assume that a privately informed insider places demands for his company's stock with a break-even (competitive) market maker. The insider is risk averse and trades conditional on the realization of a pre-emptive public signal, an endowment shock, and a private signal. The market maker is risk neutral and sets price conditional on the realization of the public signal and either the pre-announced demands placed by the insider, or, in the absence of pre-announcement, the combined order flow consisting of demands submitted by the insider and noise traders. The company is liquidated after trade takes place.

The company's liquidation value, v, is normally distributed with mean $\bar{v}$ and variance Σ_0. There is no loss in generality in further assuming that $\bar{v} = 0$. The insider's private signal is denoted $\eta = v + \epsilon$, where ϵ is normally distributed with mean 0 and variance σ_ϵ^2. The insider's endowment, z, is normally distributed with mean $\bar{z}$ and variance σ_z^2. The public signal, s, is a garbling of the insider's private signal; i.e., $s = \eta + \phi = v + \epsilon + \phi$, where ϕ is normally distributed with mean 0 and variance σ_ϕ^2. The extreme cases of no and full pre-emptive public disclosure correspond to $\sigma_\phi^2 = \infty$ and $\sigma_\phi^2 = 0$, respectively. The insider submits an order to trade x shares. Noise traders submit net orders to trade y shares. These orders are assumed to be uninformed liquidity trades and normally distributed, with mean zero. Let the variance of y be σ_y^2. If the

insider does not pre-announce him trades, then the market maker updates price based on the private signal s and the combined order flow $x + y$.

Pre-announcement of insider trades implies that the market maker can distinguish the insider's demand, x, from the net orders submitted by noise traders, y. In the analysis that follows, assuming that x can be distinguished from y when the insider preannounces is the same as assuming that $\sigma_y^2 = 0$. Thus, insider trades given pre-announcement are akin to insider trades without pre-announcement in very thinly-traded stocks. When the stock is so thinly traded that there are no noise trades, the market maker correctly conjectures that any order flow must have been generated by the insider. Hence, pre-announcement of insider trades can be viewed as a special case of no pre-announcement.

Figure 1 provides a timeline for the model.

[Figure 1]

The market maker observes s as well as x, or $x + y$, before setting price p_1, implying that the insider's portfolio is worth $v(x + z) - xp_1$ after trade. Accordingly, the insider chooses x to maximize the following certainty equivalent:

$$\begin{aligned}
&E\left[v(x+z) - xp_1 \mid \eta, z, s\right] \\
&\qquad - \frac{\rho}{2}\mathrm{Var}\left[v(x+z) - xp_1 \mid \eta, z, s\right] \\
=&E\left[v(x+z) - xp_1 \mid \eta, \phi, z\right] \\
&\qquad - \frac{\rho}{2}\mathrm{Var}\left[v(x+z) - xp_1 \mid \eta, \phi, z\right] \\
=&M\eta(x+z) - xp_1 - \frac{\rho}{2}(x+z)^2 V, \qquad (1)
\end{aligned}$$

where $M = \Sigma_0 / \left(\Sigma_0 + \sigma_\epsilon^2\right)$ and $V = M\sigma_\epsilon^2$. Suppose that a linear equilibrium exists in which

$$x = \alpha + \beta\left(M\eta - Ks\right) + \delta(z - \bar{z}), \quad \text{and} \qquad (2)$$

$$p_1 = p_s + \lambda(x + y - \mu_s), \qquad (3)$$

where $\mu_s = E[x \mid s]$, $p_s = E[v \mid s] = Ks$, and $K = \Sigma_0 / \left(\Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2\right)$. Further suppose that $p_1 = E[v \mid x + y, s]$. Thus, the insider's demand is a linear function of his information advantage and his endowment, and the market maker sets the price at which the insider trades equal to the expected value of the firm conditional on the order flow, $x + y$, and the preceding disclosure, s. In the next section, we characterize this equilibrium.

3. Equilibrium Analysis

3.1 Without Pre-announcement of Insider Trades

The first proposition describes the insider's trading strategy and the stock price in terms of the exogenous parameters.

Proposition 1: *Given partial pre-emptive public disclosure, an equilibrium can be characterized by the following endogenous parameters:*

$$\alpha = \left(\frac{\sigma_\phi^2 K}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M} - 1 \right) \bar{z}, \tag{4}$$

$$\beta = \frac{1}{\rho V} \left(\frac{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M - \sigma_\phi^2 K}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M + \sigma_\phi^2 K} \right), \tag{5}$$

$$\delta = \frac{2\sigma_\phi^2 K}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M + \sigma_\phi^2 K} - 1, \quad \textit{and} \tag{6}$$

$$\lambda = \frac{\rho \sigma_\phi^2 K V}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M - \sigma_\phi^2 K}, \tag{7}$$

where σ_y^{*2} is the unique solution to

$$\sigma_y^{*2} = (2\lambda + \rho V)\, \sigma_y^2, \tag{8}$$

and provided the second-order condition

$$\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M - \sigma_\phi^2 K > 0 \tag{9}$$

is satisfied.

The proof is in Appendix B. Note that σ_y^{*2} is an endogenous but monotone function of σ_y^2. Its effects on the other endogenous parameters is only through λ, the only endogenous parameter in (8). Clearly,

$$\frac{\partial \sigma_y^{*2}}{\partial \sigma_y^2} > 0,$$

so the comparative statics for σ_y^{*2} are the same as for σ_y^2 by the Chain Rule. Accordingly, a closed-form solution, which is non-interpretable, would not contribute further insights. Below we consider extreme cases of public disclosure choices given pre-announcement of x, or equivalently no noise trades.

The second-order condition is sufficient to ensure that the insider's expected sales are less than his expected endowment and trading intensity is less negative than in the no pre-emptive public disclosure case as we would anticipate given the incentive to distort demands based on the insider's private information. As well, the second-order condition implies that both the insider's intensity of trading based on private information and the market maker's marginal price adjustment based on pre-announced insider trades are both positive.[8]

3.2 With Pre-announcement of Insider Trades

It is evident from (10) that $\sigma_y^2 = 0$ implies $\sigma_y^{*2} = 0$. Hence we have:

Corollary 1: *Given pre-announcement by insiders and and partially informative pre-emptive public disclosure, an equilibrium can be characterized as follows:*

$$\alpha = \left(\frac{\sigma_\phi^2 K}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V} - 1 \right) \bar{z}, \tag{10}$$

$$\beta = \frac{1}{\rho V} \left(\frac{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V - \sigma_\phi^2 K}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_\phi^2 K} \right), \tag{11}$$

[8] The second order condition itself makes sense in that if the adverse selection problem is so great that the incentive to shed risk is overwhelmed by the incentive to distort trades based on private information such that it is no longer possible for the market maker to break-even, then the market shuts down and there is no trade.

$$\delta = \frac{2\sigma_\phi^2 K}{\rho^2\sigma_\epsilon^2\sigma_z^2 V + \sigma_\phi^2 K} - 1, \quad \textit{and} \tag{12}$$

$$\lambda = \frac{\rho\sigma_\phi^2 KV}{\rho^2\sigma_\epsilon^2\sigma_z^2 V - \sigma_\phi^2 K}, \tag{13}$$

provided the second-order condition

$$\rho^2\sigma_\epsilon^2\sigma_z^2 V - \sigma_\phi^2 K > 0 \tag{14}$$

is satisfied.

In order to gain some insight with respect to the above characterization of an equilibrium, we first examine the extreme cases of full pre-emptive public disclosure and no pre-emptive public disclosure. It is easy to check that an equilibrium for the limiting cases as σ_ϕ^2 goes to zero and infinity, respectively, are characterized by the following two corollaries.

Corollary 2: *Given fully informative pre-emptive public disclosure (i.e., $\sigma_\phi^2 = 0$), an equilibrium can be characterized as follows:*

$$\alpha = -\bar{z},$$

$$\beta = 1/\left(\rho\sigma_\epsilon^2\right),$$

$$\delta = -1, \quad \textit{and}$$

$$\lambda = 0.$$

The above results are intuitive. The second-order condition in this case is always satisfied because there is no adverse selection in this case. With full disclosure, the market maker adjusts price to reflect the insider's private information before trade, thereby eliminating an information based incentive to trade. The insider's only remaining motive for trading is to shed risk which he accomplishes by selling his realized endowment. The insider's expected demand is therefore to sell z. Understanding that there is no information conveyed by the insider's demands, the market maker sets marginal trading

costs equal to zero. It is notable that with full disclosure, the second order condition is always satisfied and the market can never breakdown because breakdowns only occur when asymmetric information overwhelms other incentives to trade.

Corollary 3: *Given uninformative pre-emptive public disclosure (i.e., $\sigma_\phi^2 = \infty$), an equilibrium can be characterized as follows:*

$$\alpha = \left(\frac{\Sigma_0}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M} - 1 \right) \bar{z}, \tag{15}$$

$$\beta = \frac{1}{\rho V} \left(\frac{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M - \Sigma_0}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M + \Sigma_0} \right), \tag{16}$$

$$\delta = \frac{2\Sigma_0}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M + \Sigma_0} - 1, \quad \textit{and} \tag{17}$$

$$\lambda = \frac{\rho \Sigma_0 V}{\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M - \Sigma_0}, \tag{18}$$

provided the second-order condition

$$\rho^2 \sigma_\epsilon^2 \sigma_z^2 V + \sigma_y^{*2}/M - \Sigma_0 > 0, \tag{19}$$

is satisfied.

The endogenous parameters are not qualitatively different from those in Proposition 1. The term $\sigma_\phi^2 K$ converges to Σ_0 in the limit. Of course, there is no price adjustment prior to trade in the absence of a public disclosure. A point to keep in mind for when we consider the insider's expected utility in advance of that disclosure is that price changes made by the market maker in response to the pre-emptive public disclosure impose greater risk on the insider than price changes made only in response to the order flow.

4. Comparative statics

Now we return to the general case where the market maker cannot distinguish the insider's demands from those of noise traders and consider how the insider's trading strategy and the market makers pricing strategy change as we vary the amount of noise trading. Recall that pre-announcement of insider trades is equivalent to a reduction in noise trading, so the following comparative statics illustrate the effect of such a policy.

4.1 Sensitivity to Noise Trading

Proposition 2: *A small change in the amount of noise trading affects the insider's trading strategy and market depth as follows:*

$$\frac{\partial \alpha}{\partial \sigma_y^2} < 0 \quad \text{provided } \bar{z} > 0, \tag{20}$$

$$\frac{\partial \beta}{\partial \sigma_y^2} > 0, \tag{21}$$

$$\frac{\partial \delta}{\partial \sigma_y^2} < 0, \quad \text{and} \tag{22}$$

$$\frac{\partial \lambda}{\partial \sigma_y^2} < 0. \tag{23}$$

Proof: The result follows from differentiation of (3), (4), (6), and (7) with respect to ${\sigma_y^*}^2$ and the observation that σ_y^2 is monotone in ${\sigma_y^*}^2$. ▮

A decrease in noise trading induces less trading intensity by the insider and larger price adjustments by the market maker consistent with the insider's loss of disguise. As well, the sensitivity of the insider's trades to deviations in his realized endowment from the prior expectation becomes greater as the prospect of profiting from private information diminishes. Although we have yet to determine how such a change in noise trading might affect the insider's expected utility, it can be shown that the insider is made worse off the weaker the prospects are from exploiting his private information.

4.2 Sensitivity to Informativeness of Public Disclosure

We now suppress the presence of noise trading by assuming pre-announcement of the insider's trades and consider the sensitivity of the insider's trading strategy and the market maker's pricing strategy with respect to the precision of the public signal.

Proposition 3: *A small change in the informativeness (precision) of pre-emptive public disclosure affects the insider's trading strategy and market depth as follows:*

$$\frac{\partial \alpha}{\partial \sigma_\phi^2} > 0 \quad \text{provided } \bar{z} > 0, \tag{24}$$

$$\frac{\partial \beta}{\partial \sigma_\phi^2} < 0, \tag{25}$$

$$\frac{\partial \delta}{\partial \sigma_\phi^2} > 0, \quad \text{and} \tag{26}$$

$$\frac{\partial \lambda}{\partial \sigma_\phi^2} > 0. \tag{27}$$

Proof: The result follows from differentiation of (3), (4), (6), and (7) with respect to σ_ϕ^2. ∎

As the precision of the public signal decreases, the insider can be expected to sell less of his expected endowment (increase expected demand) with less negative intensity due to the greater incentive to distort his demands based on his non-pre-empted private information. Although as previously mentioned the insider cannot profit in expectation from his private information, the less public revelation of that information the more private information remains to create that incentive. Recognizing that the insider has greater private information following the public signal, the market maker increases the marginal trading cost. Concomitantly, the insider reduces his intensity of trading on his private information anticipating these higher trading costs.

5. Insider's Welfare

5.1 Sensitivity analysis given pre-announcement

We now step back and consider the insider's welfare as we vary the precision of the public signal, endowment risk, and prior uncertainty, given pre-announcement of the insider's trades. Our analysis concludes by analyzing the effect of the amount of noise trading on the insider's preferred public disclosure policy. The insider's *ex ante* expected utility can be expressed as follows:

$$E\left[U\left(v(x+z)-xp_1\right)\right],$$

where $x = \alpha + \beta\left(M\eta - Ks\right) + \delta(z-\bar{z})$, $p_1 = p_s + \lambda(x-\mu_s)$, $p_s = E[v \mid s]$, and $\mu_s = E[x \mid s]$. The endogenous parameters λ, α, β, and δ assume the values given in Proposition 1. They are non-zero for $\phi \in (0,\infty)$. Since the function U is exponential and all random variables in the analysis are normally distributed, we use the following fact from Christensen and Feltham (2003, 106–108) to derive closed-form solutions for the *ex ante* expected utility of the insider.

Fact: *Given (i) scalars r, and f; (ii) an $n \times 1$ vector ν; and, (iii) symmetric matrix Q, all constants. Let $d \sim N(\mu, \Sigma)$ be an $n \times 1$ vector of normally distributed random variables with mean μ and variance-covariance matrix Σ. Then*

$$\begin{aligned} &E\left[\exp\left(-r\left(f+\nu' d+\tfrac{1}{2}d'Qd\right)\right)\right] \\ =&\sqrt{\frac{|H|}{|rQ+H|}}\exp\left[-\left(rf+\tfrac{1}{2}\mu' H\mu-\tfrac{1}{2}\left(r\nu-H\mu\right)'\left(rQ+H\right)^{-1}\left(r\nu-H\mu\right)\right)\right], \end{aligned}$$

where $H = \Sigma^{-1}$, provided $rQ + H$ is positive definite.

The resulting expression is not amenable to a characterization of the insider's preferences toward the precision of pre-emptive public disclosure analytically. Accordingly, we resort to numerical examples to depict the insider's expected utility as a function of σ_ϕ^2.

[Figure 2]

Figure 2 illustrates how the *ex ante* expected utility of the insider varies with the precision of the public disclosure given a parameterization such that the insider prefers an interior choice of precision. As shown by the figure, the insider's expected utility is initially increasing in the variance of the public signal. In this region, as the public signal becomes less precise, the insider faces less risk of price changes before he has an opportunity to trade, and this effect more than offsets the loss in expected utility from distortion of demands due to the insider's fruitless attempt to exploit his private information. Further loss of precision in the public signal yields less marginal reduction of price risk relative to the dysfunctional consequences of the information based component of the insider's demands.

[Figure 3]

We can gain more insight as to the forces at work from Figure 3 wherein we consider the effects of varying the risk associated with the insider's endowment on the insider's expected utility under the extreme cases of full and no pre-emptive public disclosure. The idea here is to show how different parametrizations could lead to different orderings of full and no public disclosure and, hence, further an appreciation of why insiders might prefer an interior choice of pre-emptive public disclosure precision. Under full disclosure, the insider's expected utility is decreasing because the insider's endowment is increasingly uncertain implying risk with respect to the proceeds from selling the realization.[9] His expected utility is increasing under no public disclosure because the greater the variance of his endowment then the more likely he would be trading to shed risk rather than exploit his private information, thereby reducing the marginal trading costs set by the market maker. This increase in expected utility dampens out at the variance of the endowment continues to increase.

[Figure 4]

Next, in Figure 4 we vary the prior variance of firm value as a measure of the insider's private information. Not surprisingly, the insider's expected utility is decreasing

[9] The insider's expected utility is also decreasing in his expected endowment under either full or no public disclosure because of uncertainty with respect to price.

in his private information irrespective of pre-emptive public disclosure. Under full disclosure, more private information is revealed by pre-emptive public disclosure causing the insider to face greater price risk. Under no public information, more private information implies greater distortion of demands to exploit that information and greater price risk though not as much as with full disclosure. The incremental price risk of full disclosure becomes higher as the prior variance becomes large relative to the noise in the private signal to the point where expected utility is lower in that case.

5.2 Comparing regimes with and without pre-announcement

Finally, we compare the insider's *ex ante* expected utility with and without pre-announcement depending on the thinness of the market.

[Figure 5]

In Figure 5 we allow for the presence of noise trading and examine how a change in the amount of noise trading impacts on the insider's expected utility as a function of the precision of the public signal. We can see that decreasing the amount of noise trading enhances the benefits of pre-emptive public disclosure. The family of functions depicting the insider's expected utility moves from a preference for the least informative public disclosure policy when noise trading is highest to an interior policy as noise trading diminishes. This observation suggests that a regime change to pre-announcement of insider trades could induce insiders to become less resistant to proposed accounting standards that increase the informativeness of public disclosures.

6. Conclusion

Recent corporate scandals have drawn the public's attention to the trading behavior of corporate insiders. With this attention have come proposals for changes in the regulation of insider trading that, in general, call for greater transparency than presently exist under SEC requirements. In response to allegations of trading on private information, a common *mea culpa* of insiders for their trades is that their trades were based on

motives other than the exploitation of an information advantage. This paper considers how pre-announcement of insider trades would impact on insider demands, prices set by market makers in response to those demands, and insiders' *ex ante* preferences regarding pre-emption of their information advantage through accounting standards that mandate greater public disclosure.

The principal tensions explored in our analysis are, first, the *ex post* tension between an insider's incentives to distort demands in order to take advantage of private information and to shed risk associated with an under-diversified position in shares obtained through stock compensation awards and other non-market transactions; and, second, the *ex ante* tension between the dysfunctional consequences of expected distortions in demands under less pre-emptive public disclosure and greater price risk under more pre-emptive public disclosure. Concomitantly, we consider the consequences of a change from the current regime of insiders' reporting their trades *ex post* to a regime with pre-announcement.

We derive comparative statics for the introduction of pre-announcement of insider trades. Prices become more sensitive to insider trades since they are not garbled in the order flow by uninformed trades. This increased price sensitivity leads to less extensive (and costlier) trading by the insider resulting in greater risk exposure. Combined, these effects result in reduced expected utility for the insider under such a pre-announcement regime. Of course, this loss of utility could be offset in general equilibrium by higher compensation in the executive labor market, so shareholders ultimately bear the costs.

We also derive comparative statics that depict changes in insider trading strategies and market pricing that follow from changes in the precision of pre-emptive public disclosure of firm value. The tendency of the insider to trade in order to shed risk is diminished by less precise public disclosure due to the insider's incentive to distort trades in an ineluctable effort to exploit his greater information advantage. Consistent with the prospect of private information driving insider demands, the market maker imposes larger price adjustments when public disclosure is less complete and, accordingly, the insider trades less intensely on his information.[10]

[10] These last two results are intuitive and analogous to comparative statics in other Kyle (1985)-based models of insider trading

Our principal results when we step back to consider the insider's welfare characterize his preferred precision of pre-emptive public disclosure and how his preferences vary with pre-announcement of trades (and more generally with the amount of uninformed trades offering disguise to the insider). Mandatory pre-announcement of insider trades would lead to an increase in insiders' preferred level of public disclosure, which could change political pressures, resulting in an expansion of public disclosure mandated by accounting standards. Nonetheless, it is interesting to point out that the price risk associated with price changes before insiders have an opportunity to trade can limit insiders' willingness to support accounting standards that would mandate public disclosures that fully pre-empt their information advantage.

For simplicity and ease of exposition, we chose to report only those results for the modeling choice of limiting the insider's non-private information based motives for trading to a desire to shed risk. Qualitatively similar results obtain when we assume that the insider has more varied motives. The comparative statics are somewhat more complicated when we allow for a richer portrayal of motives. However, *ex ante*, it is still a competition between the incentive to distort trades to exploit private information and the price risk associated with pre-emptive public disclosure that shapes the insider's preferences regarding that disclosure.

Policy makers seeking to discourage insiders from exploiting their access to private information for personal gain have a number of instruments available for that purpose, not limited to requiring pre-announcement of insider trades. They can seek to impose more severe penalties than currently prescribed on insiders who can be shown to have conditioned their trades on private information.[11] However, monitoring insider trades and attempting to infer whether those trades were based on private information after the fact is not a simple matter. Not only are there costs associated with monitoring and the legal machinery of sanctions, but, as Spiegel and Subrahmanyam (2000) suggest, there may be strategic effects such that prosecution based on price changes as a measure of

[11] Beneish (1999) points out that neither the prospect of loss of employment or SEC imposed penalties are sufficient to deter insider trading on private information.

insider trading could actually be misdirected toward insiders with less precise private information. Moreover, the notion that insiders must trade to enjoy stock-based compensation suggests that policies designed to punish insiders for trades that might be construed as improper from circumstantial evidence makes such compensation unattractive, even though stock-based may be efficient in resolving agency conflicts.

Another policy instrument is to directly mandate accounting standards that would result in public disclosure that pre-empts private information based trades. One difficulty here as previously mentioned is that accounting standards that expand disclosure have often encountered strong and effective resistance from corporate executives in a context without pre-announcement of insider trades. A consequence of policies that require or otherwise induce pre-announcement of insider trades is that pre-announcement tends to better align the preferences of corporate insiders and accounting standard setters who seek to expand public disclosure.

Yet a further instrument is the affirmative defense against prosecution of insiders for trading on private information afforded through pre-commitment by Rule 105b-1. However, the effect of pre-commitment in deterring information-based trading is questionable. Ke, Huddart, and Petroni (2003) find that insiders know and trade upon foreknowledge of earnings as long as two years before the earnings announcement, which suggests that insiders may pre-commit well in advance of trading (anonymously) and still succeed in exploiting their information advantage. Jagolinzer (2004), who finds that pre-committed trades undertaken through the Rule 10b5-1 yield abnormal profits to insiders, offers direct evidence that insiders succeed in exploiting their information advantage notwithstanding pre-commitment.

To parse out the consequences of pre-announcement of trades by insiders, we have implicitly assumed away the presence of other factors that may influence preferences of corporate executives regarding accounting standards. One such factor may be the possibility that greater information asymmetry may imply a higher cost of capital. Hence, firms may seek to resolve such an asymmetry through adoption of accounting

policies that expand disclosure.[12] Another factor could be heightened political fallout from being seen to oppose accounting standards calling for an expansion of public disclosure. A further limitation of our analysis is that we suppress issues pertaining to the potential role of public disclosure in restricting the scope for insiders to manipulate accounting numbers. Whether these omitted factors significantly detract from a reliance on pre-announcement of insider trades to curb abuses is an empirical question.

[12] Recent empirical research by Easley, Hvidkjaer, and O'Hara (2002), Francis, LaFond, Olsson, and Schipper (2003), Botosan and Plumlee (2004), and Aboody, Hughes, and Liu (2004) suggests an association between asymmetric information and cost of capital that might be driven by uninformed traders requiring a premium as compensation for trading against insiders.

Appendix A: Motives for Insider Trades

Here are several excerpts from the financial press containing reasons offered for insider trades:

(1) "The latest insider selling, most of which was options-related, reflected a desire by the officers and directors to diversify..." Antec *The Atlanta Journal and Constitution* March 28,1999.

(2) "In one of the biggest executive votes of confidence in a long time, Microsoft Vice President Steven Ballmer spent $46.2 million late last month to buy shares in the software maker." Microsoft *USA Today* April 17,1989.

(3) "The fact of the matter is that up until a few months ago, insiders in Nona were paid in stock rather than cash for their services ... insiders like Doug have to sell positions in their stock in order to feed their families ..." Nona Morellis II *PR Newswire* April 16, 1996.

(4) "According to the company, the sale of stock in the open market was to repay personal debt and for tax reasons." Supercuts *Business Wire* December 30, 1992.

(5) "The sale was to fund the construction of a summer camp in Wyoming for disadvantaged and at-risk youth ... It's his own individual initiative." Coca-Cola Enterprises *The Atlanta Journal and Constitution* May 24, 1999.

(6) "This arrangement clearly delineates the intentions of our key insiders ... They have flexibility in diversifying their portfolios, but maintain a substantial commitment to their investment in U. S. Robotics." U.S. Robotics *PR Newswire* August 10, 1993.

(7) "Tuesday, Campbell Soup announced a plan to require CEO David Johnson and 69 other top executives to hold stock worth one-half to three times their salaries." Campbell Soup *USA Today*, May 5, 1993.

(8) "We are pleased that these principals [referring to corporate insiders] have the confidence in our business to further enhance their stock positions in VTC." Virtual Technology Corporation *Business Wire*, September 7, 1999.

(9) "... today announced recent purchases of common stock by each of its executive officers. ... All of these transactions were related to the exercise of non-qualified stock options with the intent to hold the stock." American Healthcorp *Business Wire*, May 4, 1999.

(10) "On the surface, that $7.5 million worth of buying could have been viewed as evidence that Mr. Goings is confident about the future of Tupperware's stock price .... But a closer look indicates that ... the purchase was financed by an $8 million interest-free loan from the company itself." Tupperware *Wall Street Journal*, January 13, 1999.

Appendix B: Proofs

Proof of Proposition 1: The first-order condition on (1) with respect to x for an arbitrary realization of the public signal s, the insider's endowment, z, and private signal, η, is

$$M\eta - p_s - 2\lambda x + \mu_s\lambda - \rho(x+z)V = 0. \tag{B.1}$$

Equation (B.1) implies

$$\begin{aligned} x &= \frac{M\eta - p_s - \rho z V + \mu_s\lambda}{2\lambda + \rho V} \\ &= \frac{M\eta - Ks - \rho z V + \mu_s\lambda}{2\lambda + \rho V}. \end{aligned} \tag{B.2}$$

Since $\mu_s = E[x \mid s]$, (B.2) implies

$$\begin{aligned} \mu_s(2\lambda + \rho V) &= (M-K)E[\eta \mid s] - KE[\phi \mid s] - \rho E[z \mid s]V + \mu_s\lambda. \\ &= \rho\bar{z}V + \mu_s\lambda. \end{aligned} \tag{B.3}$$

Expression (B.3) follows because:

$$\begin{aligned} (M-K)E[\eta \mid s] - KE[\phi \mid s] = 0, \quad &\text{and} \\ E[z \mid s] = \bar{z}, \end{aligned} \tag{B.4}$$

Equation (B.4) follows from the defintions of M and K given the conditional probabilities:

$$\begin{aligned} E[\eta \mid s] &= \frac{\Sigma_0 + \sigma_\epsilon^2}{\Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2} s, \quad \text{and} \\ E[\phi \mid s] &= \frac{\sigma_\phi^2}{\Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2} s, \end{aligned}$$

In equilibrium, (B.2) and (B.3) imply

$$\mu_s = \alpha = -\frac{\rho V \bar{z}}{\lambda + \rho V}, \tag{B.5}$$

$$\beta = \frac{1}{2\lambda + \rho V}, \tag{B.6}$$

$$\delta = -\frac{\rho V}{2\lambda + \rho V}. \tag{B.7}$$

The vector of random variables

$$\begin{pmatrix} v \\ \epsilon \\ \phi \\ y \\ z \end{pmatrix}$$

is jointly normally distributed with mean

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \bar{z} \end{pmatrix},$$

and variance-covariance matrix

$$Q = \begin{pmatrix} \Sigma_0 & 0 & 0 & 0 & 0 \\ 0 & \sigma_\epsilon^2 & 0 & 0 & 0 \\ 0 & 0 & \sigma_\phi^2 & 0 & 0 \\ 0 & 0 & 0 & \sigma_y^2 & 0 \\ 0 & 0 & 0 & 0 & \sigma_z^2 \end{pmatrix}.$$

Thus, the vector of random variables

$$\begin{pmatrix} v \\ x+y \\ s \end{pmatrix}$$

is also jointly normally distributed with mean

$$\begin{pmatrix} 0 \\ -\frac{\rho V \bar{z}}{\lambda + \rho V} \\ 0 \end{pmatrix}$$

and variance-covariance matrix

$$\begin{aligned} & HQH' \\ = & \begin{pmatrix} \Sigma_0 & \beta\left(M-K\right)\Sigma_0 & \Sigma_0 \\ \beta\left(M-K\right)\Sigma_0 & \beta^2\left(\frac{(M-K)^2}{M}\Sigma_0 + K^2\sigma_\phi^2\right) + \sigma_y^2 + \delta^2\sigma_z^2 & \beta\left(\frac{M-K}{M}\Sigma_0 - K^2\sigma_\phi^2\right) \\ \Sigma_0 & \beta\left(\frac{M-K}{M}\Sigma_0 - K^2\sigma_\phi^2\right) & \Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2 \end{pmatrix}, \end{aligned}$$

since

$$\begin{pmatrix} v \\ x+y \\ s \end{pmatrix} = \begin{pmatrix} 0 \\ -\frac{\rho V \bar{z}}{\lambda+\rho V} \\ 0 \end{pmatrix} + H \begin{pmatrix} v \\ \epsilon \\ \phi \\ y \\ z \end{pmatrix}$$

for

$$H = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ \beta(M-K) & \beta(M-K) & -\beta\kappa & 1 & \delta \\ 1 & 1 & 1 & 0 & 0 \end{pmatrix}.$$

Following DeGroot (1970, 55), the variance-covariance matrix for $(v\ x+y)'$ conditional on s is given by

$$\begin{pmatrix} \Sigma_0 & \beta\,(M-K)\,\Sigma_0 \\ \beta\,(M-K)\,\Sigma_0 & \beta^2\left(\frac{(M-K)^2}{M}\Sigma_0 + K^2\sigma_\phi^2\right) + \sigma_y^2 + \delta^2\sigma_z^2 \end{pmatrix}$$

$$-\frac{\begin{pmatrix} \Sigma_0 \\ \beta\left(\frac{M-K}{M}\Sigma_0 - K^2\sigma_\phi^2\right) \end{pmatrix}\begin{pmatrix} \Sigma_0 & \beta\left(\frac{M-K}{M}\Sigma_0 - K^2\sigma_\phi^2\right) \end{pmatrix}}{\Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2}.$$

Thus,

$$\begin{aligned} \mathrm{Cov}(v, x+y \mid s) &= \frac{\beta M \Sigma_0 \sigma_\phi^2}{\Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2} \\ &= \frac{KM\sigma_\phi^2}{2\lambda + \rho V} \quad \text{and} \\ \mathrm{Var}(x+y \mid s) &= \sigma_y^2 + \delta^2\sigma_z^2 + \frac{\beta^2 M^2 \sigma_\phi^2 (\Sigma_0 + \sigma_\epsilon^2)}{\Sigma_0 + \sigma_\epsilon^2 + \sigma_\phi^2} \\ &= \sigma_y^2 + \delta^2\sigma_z^2 + \frac{KM\sigma_\phi^2}{(2\lambda + \rho V)^2} \end{aligned}$$

Furthermore, from the market maker's breakeven condition,

$$p_1 = E(v \mid x+y, s) = p_s + \frac{\mathrm{Cov}(v, x+y \mid s)}{\mathrm{Var}(x+y \mid s)}(x+y-\mu_s),$$

we have

$$\begin{aligned}
\lambda &= \frac{\mathrm{Cov}(v, x+y \mid s)}{\mathrm{Var}(x+y \mid s)} \\
&= \frac{(2\lambda+\rho V)KM\sigma_\phi^2}{(2\lambda+\rho V)^2\sigma_y^2 + (2\lambda+\rho V)^2\delta^2\sigma_z^2 + KM\sigma_\phi^2} \\
&= \frac{(2\lambda+\rho V)KM\sigma_\phi^2}{\sigma_y^{*2} + \rho^2 V^2\sigma_z^2 + KM\sigma_\phi^2},
\end{aligned}$$

where $\sigma_y^{*2} \equiv (2\lambda+\rho V)^2\sigma_y^2$. Solving this last equality for λ gives:

$$\lambda = \frac{\rho KMV\sigma_\phi^2}{\sigma_y^{*2} + \rho^2 V^2\sigma_z^2 - KM\sigma_\phi^2},$$

which reduces to (7). Substituting (7) into (B.4) –(B.7) gives (3), (4), and (6), respectively. The second-order condition is

$$-2\lambda - \rho V \leq 0. \tag{B.8}$$

By substitution and rearrangement, (B.8) reduces to (9). ∎

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↑	↑	↑	↑	↑
The insider learns her endowment, z, and private information, η.	Public disclosure, s, is made.	Either (i) the insider publicly announces his trade, x, or (ii) the net order flow, $x+y$, is submitted to the market maker	The market maker sets the stock price, p_1, at which the insider trades.	Liquidation values are realized.

Figure 1. Timeline.

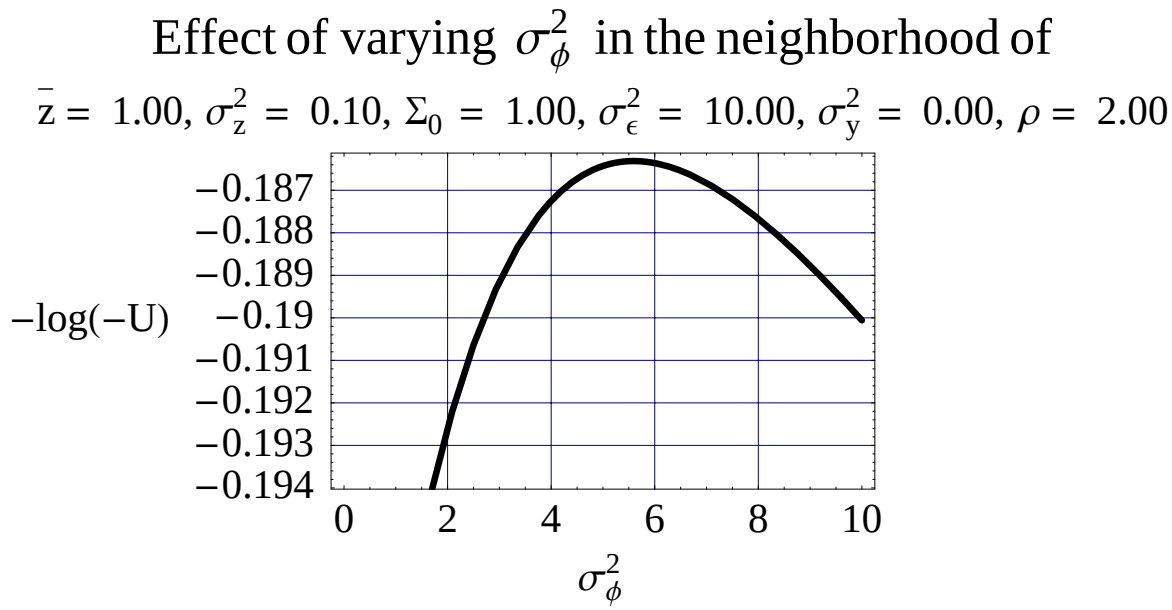

Figure 2. Expected utility as a function of σ_ϕ^2.

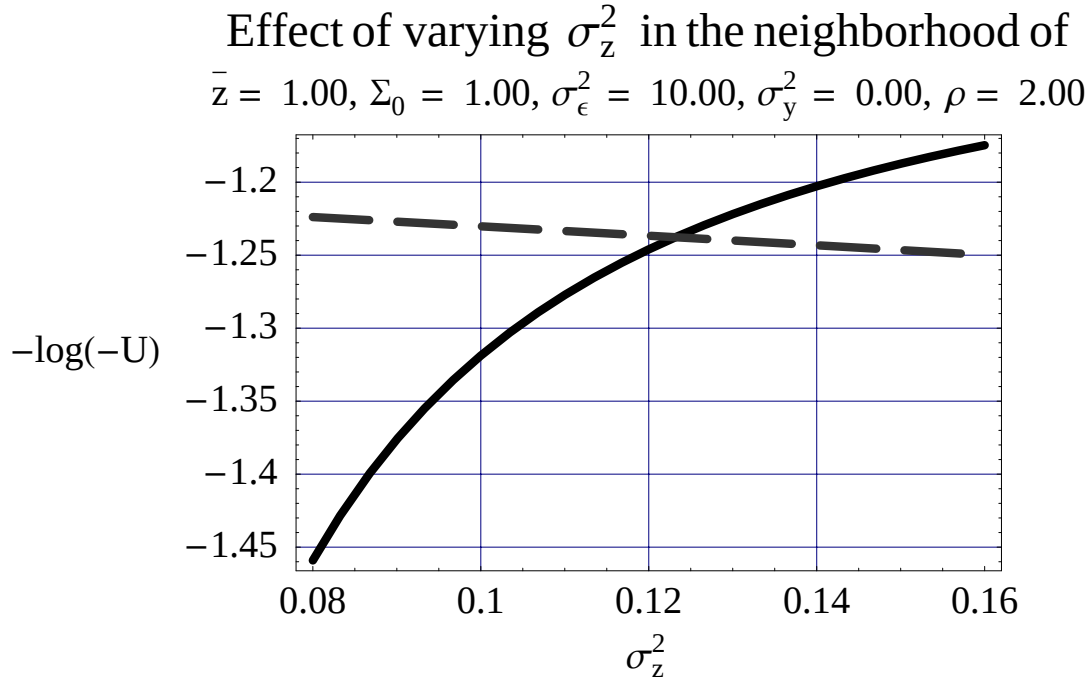

Figure 3. Expected utility as a function of σ_z^2. The solid black line corresponds to no disclosure, i.e., $\sigma_\phi^2 = \infty$. The dashed gray line corresponds to full disclosure, i.e., $\sigma_\phi^2 = 0$.

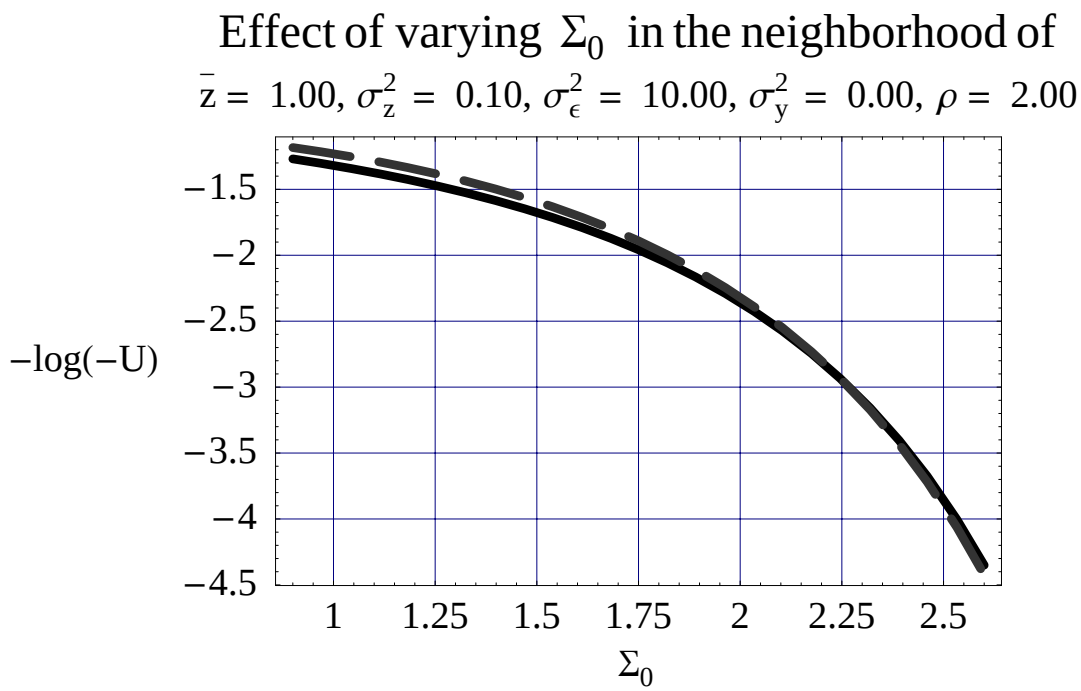

Figure 4. Expected utility as a function of Σ_0. The solid black line corresponds to no disclosure, i.e., $\sigma_\phi^2 = \infty$. The dashed gray line corresponds to full disclosure, i.e., $\sigma_\phi^2 = 0$.

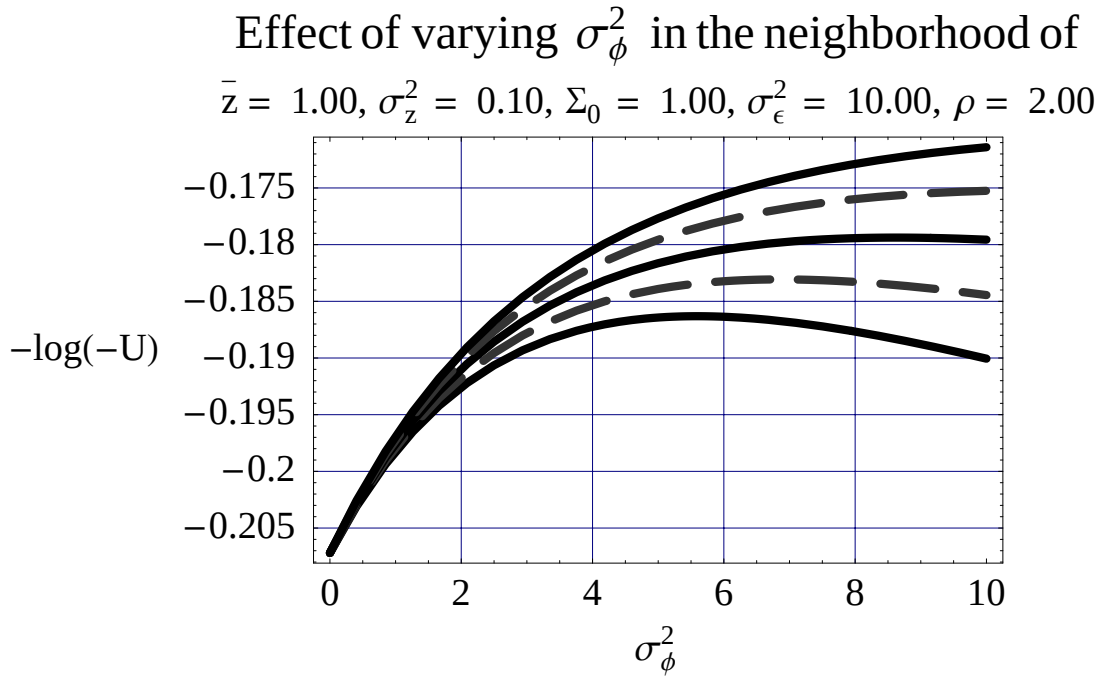

Figure 5. Expected utility as a function of σ_ϕ^2 for a variety of values of σ_y^2. From bottom to top, the lines correspond to increasing variability of liquidity trades, $\sigma_y^2 = 0.00$, 0.02, 0.04 0.06, 0.08, and 0.10, respectively.