Internet Appendix to "Blockholder Trading, Market Efficiency, and Managerial Myopia"*

IA.A. Costly Short-Sales

The blockholder can now short-sell, but faces a short-sales cost of $\tau(\beta-\alpha)^2$ if she sells $\beta > \alpha$. Upon receiving i_b, she chooses β to solve

$$\max \beta e^{-\lambda\beta} X \left[\frac{1+e^{-\lambda\widehat{\beta}}+\mu\left(1-e^{-\lambda\widehat{\beta}}\right)}{2\left(1+e^{-\lambda\widehat{\beta}}\right)} - \frac{1-\mu}{2} \right] - \tau\left[\max((\beta-\alpha),0)\right]^2.$$

There are three possible solutions: $\beta = \alpha$, $\beta = \frac{1}{\lambda} < \alpha$, or $\frac{1}{\lambda} > \beta > \alpha$. Since the first two solutions are as in the core model, the analysis here focuses on the third solution. The first-order condition is

$$\frac{(1-\beta\lambda)e^{-\lambda\beta}}{1+e^{-\lambda\beta}}\mu X - 2\tau(\beta-\alpha) = 0.$$

Since $\lambda = \dfrac{1}{\nu(1-\alpha)}$, we obtain

$$\left[\nu(1-\alpha)-\beta\right]\frac{\mu X}{2\tau\nu} = (1-\alpha)(\beta-\alpha)(1+e^{\frac{\beta}{\nu(1-\alpha)}}).$$

Using $\mu = \frac{\beta X}{4c}$ and defining $D = \dfrac{X^2}{8\tau\nu c}$ yields

$$\left[\nu(1-\alpha)-\beta\right]\beta D = (1-\alpha)(\beta-\alpha)(1+e^{\frac{\beta}{\nu(1-\alpha)}}).$$

Taking the partial derivative with respect to α on both sides gives

$$\begin{aligned}
&\left(-\nu-\frac{\partial\beta}{\partial\alpha}\right)\beta D + \left[\nu(1-\alpha)-\beta\right]\frac{\partial\beta}{\partial\alpha}D \\
&= -(\beta-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}\right) + (1-\alpha)\left(\frac{\partial\beta}{\partial\alpha}-1\right)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}\right) \\
&+ (1-\alpha)(\beta-\alpha)e^{\frac{\beta}{\nu(1-\alpha)}}\left[\frac{\partial\beta}{\partial\alpha}\frac{1}{\nu(1-\alpha)} + \frac{\beta}{\nu(1-\alpha)^2}\right],
\end{aligned}$$

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and so

$$\frac{\partial\beta}{\partial\alpha}\left[-\beta D+[\nu(1-\alpha)-\beta]\,D-(1-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}\right)-(1-\alpha)\frac{(\beta-\alpha)e^{\frac{\beta}{\nu(1-\alpha)}}}{\nu(1-\alpha)}\right]$$
$$=\nu\beta D-(\beta-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}\right)-(1-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}\right)+(1-\alpha)(\beta-\alpha)e^{\frac{\beta}{\nu(1-\alpha)}}\frac{\beta}{\nu(1-\alpha)^2}.$$

To conclude that $\frac{\partial\beta}{\partial\alpha}>0$, it is sufficient to show that

$$\nu\beta D-(\beta-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}\right)-(1-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}-(\beta-\alpha)e^{\frac{\beta}{\nu(1-\alpha)}}\frac{\beta}{\nu(1-\alpha)^2}\right)<0 \quad \text{(IA.1)}$$

and

$$-\beta D+[\nu(1-\alpha)-\beta]\,D-(1-\alpha)\left(1+e^{\frac{\beta}{\nu(1-\alpha)}}+\frac{(\beta-\alpha)e^{\frac{\beta}{\nu(1-\alpha)}}}{\nu(1-\alpha)}\right)<0. \quad \text{(IA.2)}$$

We wish to show that $\frac{\partial\beta}{\partial\alpha}>0$, that is, as α rises from zero, B trades more (as in the core model). When $\alpha=0$, inequality (IA.1) becomes

$$\nu\beta D-\beta\left(1+e^{\frac{\beta}{\nu}}\right)-\left(1+e^{\frac{\beta}{\nu}}-\frac{\beta^2e^{\frac{\beta}{\nu}}}{\nu}\right)<0$$

$$D<\frac{(1+\beta)+\left(1+\beta-\frac{\beta^2}{\nu}\right)e^{\frac{\beta}{\nu}}}{\nu\beta}. \quad \text{(IA.3)}$$

Note that we have $\beta<\frac{1}{\lambda}$ as a solution. For $\alpha=0$, this equates to $\beta<\nu$. Hence, $\beta-\frac{\beta^2}{\nu}=\frac{\beta(\nu-\beta)}{\nu}>0$, and so the right-hand side is positive. Equation (IA.3) becomes

$$\frac{X^2}{8\tau c}<\frac{(1+\beta)+\left(1+\beta-\frac{\beta^2}{\nu}\right)e^{\frac{\beta}{\nu}}}{\beta}. \quad \text{(IA.4)}$$

This condition is most stringent when the right-hand side is smallest. Differentiating the right-hand side with respect to β and ignoring the denominator yields

$$\beta\left[1+\left(1-\frac{2\beta}{\nu}\right)e^{\frac{\beta}{\nu}}+\frac{1}{\nu}\left(1+\beta-\frac{\beta^2}{\nu}\right)e^{\frac{\beta}{\nu}}\right]-1-\beta-\left(1+\beta-\frac{\beta^2}{\nu}\right)e^{\frac{\beta}{\nu}}$$
$$=-1+e^{\frac{\beta}{\nu}}\left[\beta\left(1-\frac{2\beta}{\nu}\right)+\left(\frac{\beta}{\nu}-1\right)\left(1+\beta-\frac{\beta^2}{\nu}\right)\right]$$
$$=-1+e^{\frac{\beta}{\nu}}\left[\beta-\frac{2\beta^2}{\nu}+\frac{\beta}{\nu}+\frac{\beta^2}{\nu}-\frac{\beta^3}{\nu^2}-1-\beta+\frac{\beta^2}{\nu}\right]$$
$$=-1+e^{\frac{\beta}{\nu}}\left[\frac{\beta}{\nu}-\frac{\beta^3}{\nu^2}-1\right],$$

which is negative since $\frac{\beta}{\nu}<1$. Hence, the right-hand side of (IA.4) is smallest when β is at its maximum value of ν. Then we have

$$\begin{aligned}\frac{X^2}{8\tau c} &< \frac{1+\nu+e}{\nu}\\ \tau &> \frac{X^2}{8c}\frac{\nu}{1+\nu+e}.\end{aligned}$$

When $\alpha = 0$, the second inequality, (IA.2), becomes

$$(\nu - 2\beta)\, D - \left(1 + e^{\frac{\beta}{\nu}} + \frac{\beta e^{\frac{\beta}{\nu}}}{\nu}\right) < 0.$$

If $\beta > \frac{\nu}{2}$, the left-hand side is automatically satisfied so this constraint can be ignored. We consider $\beta < \frac{\nu}{2}$ and thus obtain

$$D < \frac{\left(1 + \left(1 + \frac{\beta}{\nu}\right) e^{\frac{\beta}{\nu}}\right)}{\nu - 2\beta}.$$

The right-hand side is lowest when β is lowest, as this reduces the numerator and increases the denominator. Setting $\beta = 0$ yields

$$\begin{aligned}\frac{X^2}{8\tau\nu c} &< \frac{2}{\nu}\\ \tau &> \frac{X^2}{16c}.\end{aligned}$$

Overall, a sufficient condition for $\frac{\partial\beta}{\partial\alpha}$ at $\alpha = 0$ is

$$\tau > \frac{X^2}{8c}\max\left(\frac{\nu}{1+\nu+e}, \frac{1}{2}\right).$$

If this condition is satisfied, if α rises from zero, B's optimal sale volume also increases (positive trading effect). This in turn increases her monitoring effort (positive effort effect). Combined with the direct effect of α on liquidity (positive camouflage effect), the rise in α augments market efficiency and thus investment. As in the core model, if α rises too high, liquidity becomes a constraint and so β declines.

IA.B. Blockholder Purchases

We now allow B to buy up to $\overline{\gamma}$ upon receiving i_g.[1] For simplicity, we return to the main model with short-sale constraints, although again the results are robust to replacing them with short-sales costs.

If B receives i_g, her objective function is

$$\max_{\gamma \leq \overline{\gamma}} \gamma X \int_0^{\infty} \left[\frac{1+\mu}{2} - \frac{1 + e^{-\lambda\left(\widehat{\beta}+\widehat{\gamma}\right)} + \widehat{\mu}\left(1 - e^{-\lambda\left(\widehat{\beta}+\widehat{\gamma}\right)}\right)}{2\left(1 + e^{-\lambda\left(\widehat{\beta}+\widehat{\gamma}\right)}\right)} \right] \lambda e^{-\lambda u} du.$$

If B buys γ, the market maker observes $d = u + \gamma$. However, since u has no upper bound, this value of d is both consistent with B having bought and B having sold. Therefore, B earns a trading profit regardless of the realized value of u[2], and so the integral is over the full domain of u (from 0 to ∞). The first-order condition is always positive, and so B chooses $\gamma = \overline{\gamma}$.

If $d < \gamma$ (i.e., $u < \beta + \gamma$), the market maker knows that B has not bought, and therefore must have sold. Hence, he sets price $\pi_b X$. This contrasts with the core model, where the price is $\pi_b X$ only if $d < 0$ (i.e., $u < \beta$). Hence, if B receives i_b, her objective function is

$$\max_{\beta \leq \alpha} \beta X \int_{\beta+\gamma}^{\infty} \left[\frac{1 + e^{-\lambda\left(\widehat{\beta}+\gamma\right)} + \widehat{\mu}\left(1 - e^{-\lambda\left(\widehat{\beta}+\gamma\right)}\right)}{2\left(1 + e^{-\lambda\left(\widehat{\beta}+\gamma\right)}\right)} - \frac{1-\mu}{2} \right] \lambda e^{-\lambda u} du$$

and she chooses $\beta = \min(\frac{1}{\lambda}, \alpha)$ as before.

The blockholder's objective function for her monitoring decision is

$$\begin{aligned} &\frac{1}{2}\beta X \left[e^{-\lambda(\beta+\gamma)} \frac{1 + e^{-\lambda(\beta+\gamma)} + \widehat{\mu}\left(1 - e^{-\lambda(\beta+\gamma)}\right)}{2\left(1 + e^{-\lambda(\beta+\gamma)}\right)} + \left(1 - e^{-\lambda(\beta+\gamma)}\right) \frac{1-\widehat{\mu}}{2} - \frac{1-\mu}{2} \right] \\ &+ \frac{1}{2}\gamma X \left[\frac{1+\mu}{2} - \frac{1 + e^{-\lambda(\beta+\gamma)} + \widehat{\mu}\left(1 - e^{-\lambda(\beta+\gamma)}\right)}{2\left(1 + e^{-\lambda(\beta+\gamma)}\right)} \right] - \frac{1}{2}c\mu^2 \end{aligned}$$

and so she exerts effort level

$$\mu = \frac{(\beta+\gamma) X}{4c},$$

[1] An upper bound on purchases (which result from, say, wealth constraints) is a feature of many informed trading models, for example, Admati and Pfleiderer (2009), Boot and Thakor (1993), Dow, Goldstein, and Guembel (2007), Fulghieri and Lukin (2001), Goldstein, Ozderonen, and Yuan (2008), Kahn and Winton (1998), and Manove (1989). In particular, it is a necessary feature of any model with exponential liquidity trader demand as, otherwise, the optimal purchase would be infinite (see also Barlevy and Veronesi (2000), who also use an exponential distribution and limit purchases). The results of the model will hold under normally distributed liquidity trader demand, where purchases do not have to be restricted; however, the model would not be solvable in closed form. The idea that a rise in α allows B to sell more upon negative information, thus inducing her to gather more information in the first place, is not dependent upon the functional form for liquidity trader demand.

[2] Indeed, the level of B's profit is independent of u. This is allied to the "memorylessness" property of exponential distributions.

which is increasing in α.

Hence, as in the core model, a rise in α increases β, increases μ, and reduces λ. The trading, effort and camouflage effects of an increase in α are thus all as in the core model, and so the results still hold. The intuition is that, while B's purchase volume is independent of α, it remains the case that her sale volume is increasing in α (for $\alpha < \frac{\nu}{\nu+1}$). Hence, it remains the case that a rise in α increases B's trading profits from private information, and thus her incentives to gather information in the first place.

IA.C. Known Investment Opportunity

In the core model, the availability of the investment opportunity θ is known only to M. This section shows that the results are robust to allowing θ to be known also to B and the market maker.

Let $\widehat{\theta}$ be the conjecture possessed by B and the market maker regarding the investment level undertaken by a high-quality firm. The blockholder therefore believes the fundamental value of a high-quality firm is $X + g\widehat{\theta}$, and so monitors with intensity

$$\mu = \frac{\beta\left(X + g\widehat{\theta}\right)}{4c}. \tag{IA.5}$$

Let $\widehat{\mu}$ be M's conjecture regarding B's monitoring effort. His objective function becomes

$$(1-\omega)\left(X+g\theta\right) + \omega\theta^2\widehat{\pi_X}\left(X+g\widehat{\theta}\right) + \omega(1-\theta^2)\left(X+g\widehat{\theta}\right),$$

where

$$\widehat{\pi_X} = \frac{1}{2}\left(\widehat{\mu}^2\frac{1-e^{-\lambda\beta}}{1+e^{-\lambda\beta}} + 1\right).$$

Since the market maker conjectures an investment level of $\widehat{\theta}$, the $t = 2$ stock price is a function of $X + g\widehat{\theta}$. The manager's optimal investment level is given by

$$\theta = \frac{(1-\omega)\,g}{2\omega\left(X+g\widehat{\theta}\right)\left(1-\widehat{\pi_X}\right)}.$$

In equilibrium, $\theta = \widehat{\theta}$, and so θ is implicitly defined by

$$\theta = \frac{(1-\omega)\,g}{2\omega\left(X+g\theta\right)\left(1-\frac{1}{2}\left(\frac{\beta^2(X+g\theta)^2}{16c^2}\frac{1-e^{-\lambda\beta}}{1+e^{-\lambda\beta}}+1\right)\right)}.$$

We wish to show that θ is weakly increasing (decreasing) in α for $\alpha < (>)\alpha^*$, as in the core model. We first consider the case of $\alpha < \alpha^*$, and so $\beta = \alpha$. We therefore have

$$\theta(X+g\theta)\left[1-L(X+g\theta)^2\right] = \frac{(1-\omega)g}{\omega}$$
$$F(\theta,\alpha) = \ln\theta + \ln(X+g\theta) + \ln\left[1-L(X+g\theta)^2\right] = \ln\frac{(1-\omega)g}{\omega}, \tag{IA.6}$$

where

$$L = \frac{\alpha^2}{16c^2}\frac{1-e^{-\frac{\alpha}{\nu(1-\alpha)}}}{1+e^{-\frac{\alpha}{\nu(1-\alpha)}}}. \tag{IA.7}$$

Since all three components of $F(\theta,\alpha)$ are concave in θ, there are potentially two values of θ that make $F(\theta,\alpha) = \ln\frac{(1-\omega)g}{\omega}$. Since $F(0) = -\infty$ and $\frac{\partial F}{\partial\theta} > 0$, it is sufficient to show that $\frac{\partial F}{\partial\theta} > 0$ at the maximum value of $\theta = 1$ to prove that there is at most one $\theta \in [0,1]$ where (IA.6) holds. We have

$$\frac{\partial F}{\partial\theta} = \frac{1}{\theta} + \frac{g}{X+g\theta} - \frac{2Lg(X+g\theta)}{1-L(X+g\theta)^2}.$$

Using $\mu \le 1$ and $\alpha \le \frac{\nu}{\nu+1}$, this yields

$$1-L(X+g\theta)^2 = 1-\mu^2\frac{1-e^{-\frac{\alpha}{\nu(1-\alpha)}}}{1+e^{-\frac{\alpha}{\nu(1-\alpha)}}} \ge 1-\frac{1-e^{-1}}{1+e^{-1}}, \tag{IA.8}$$

which implies that

$$L(X+g\theta)^2 \le \frac{e-1}{e+1}$$
$$L(X+g\theta) \le \frac{e-1}{e+1}\frac{1}{X+g\theta}. \tag{IA.9}$$

Therefore,

$$\begin{aligned}
\frac{\partial F}{\partial\theta} &\ge \frac{1}{\theta} + \frac{g}{X+g\theta} - \left[1-\frac{1-e^{-1}}{1+e^{-1}}\right]^{-1} 2Lg(X+g\theta) \text{ (from (IA.8))} \\
&= \frac{1}{\theta} + \frac{g}{X+g\theta} - (e+1)gL(X+g\theta) \\
&\ge \frac{1}{\theta} + \frac{g}{X+g\theta} - (e+1)g\frac{e-1}{e+1}\frac{1}{X+g\theta} \text{ (from (IA.9))} \\
&= \frac{1}{\theta} + \frac{g}{X+g\theta} - (e-1)\frac{g}{X+g\theta}.
\end{aligned}$$

We have that

$$\begin{aligned}
\frac{\partial F}{\partial\theta}\Big|_{\theta=1} &\ge 1 + \frac{g}{X+g} - (e-1)\frac{g}{X+g} \\
&= 1 - \frac{(e-2)g}{X+g} \\
&\ge 1-(e-2) > 0.
\end{aligned}$$

Hence, there can be at most one value of $\theta \in [0,1]$ for which $F(\theta,\alpha) = \ln\frac{(1-\omega)g}{\omega}$. If $F(\theta,\alpha) = \ln\frac{(1-\omega)g}{\omega}$ for some θ, this θ is chosen by the manager. If $F(\theta,\alpha) < \ln\frac{(1-\omega)g}{\omega}$ for all $\theta \in [0,1]$, then $\theta = 1$. In either case, $\frac{\partial F}{\partial \theta} > 0$.

Differentiating $F(\theta,\alpha)$ with respect to α gives

$$\frac{\partial F}{\partial \alpha} + \frac{\partial F}{\partial \theta}\frac{\partial \theta}{\partial \alpha} = 0. \tag{IA.10}$$

From (IA.6) and the definition of L in (IA.7), it is immediate that $F(\theta,\alpha)$ is decreasing in α. Moreover, since $\frac{\partial F}{\partial \theta} > 0$, we have $\frac{\partial \theta}{\partial \alpha} \geq 0$ as required, with a strict inequality if $\theta < 1$.

Now consider $\alpha > \frac{\nu}{\nu+1}$. We have

$$F(\theta,\alpha) = \ln\theta + \ln(X + g\theta) + \ln\left[1 - L(X+g\theta)^2\right] = \ln\frac{(1-\omega)g}{\omega}, \tag{IA.11}$$

where

$$L = \frac{\nu^2(1-\alpha)^2}{16c^2}\frac{1-e^{-1}}{1+e^{-1}}.$$

Again, $F(\alpha)$ is concave in θ. Following the exact same steps as earlier gives

$$\frac{\partial F}{\partial \theta}|_{\theta=1} \geq 1 - (e-2) > 0.$$

As before, we have $\frac{\partial F}{\partial \theta} > 0$. From (IA.11), it is immediate that $F(\theta,\alpha)$ is increasing in α. Moreover, since $\frac{\partial F}{\partial \theta} > 0$, (IA.10) implies that $\frac{\partial \theta}{\partial \alpha} \leq 0$ as required.

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