Confidential Treatment Requests

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Abstract

We study the impact of confidential treatment requests made by institutional investors to the Securities and Exchange Commission (SEC) to delay disclosure of their holdings. The SEC requires the manager to present a coherent on-going trading program in his request for confidential treatment. If granted, he is restricted to trade in a manner consistent with his reported forecast in the subsequent period. Under the restriction, the manager earns higher expected profits by applying for confidential treatment only if his probability of success exceeds a threshold. The model predicts that the price impact of a disclosed trade due to a confidential treatment request denial is greater than that of a disclosed trade where there is no request.

1 Introduction

Regular mandatory disclosure of holdings by institutional investors allows fund investors to better evaluate the performance of the funds and help them in their asset allocation and diversification decision. However, it also has its drawbacks[1]. Specifically, other market participants may copy the trades of the investment managers and thus free-ride on the latter's research expertise. Frank et al. (2004), and Wang and Varbeek (2010) use the term copycat funds to describe these investors[2]. The mimicking trades of these copycats would make it more expensive for the investment managers if they decide to acquire more shares in subsequent quarters. This may have negative consequences on informational efficiency of markets if mandatory disclosure reduces the information acquisition efforts of institutional investors. To balance the competing interests, a provision in Section 13(f) allows them to seek confidential treatment for some of their holdings. If approved by the SEC, these holdings will be disclosed at a later date, usually up to one year.

We show that confidential treatment requests impacts the trading strategy and expected profits of institutional investors and the price informativeness of disclosed trades. In this model, we examine the trading strategy of an informed investment manager when he applies for confidential treatment. We assume that the manager seeks confidential treatment on his initial trade to better exploit his private information on the asset over two trading periods[3]. The manager trades in the first period and applies for confidential treatment on

[1]See Wermers (2001) on a discussion of how more frequent mandatory disclosure of mutual funds could potentially reduce their profits.

[2]Frank et al. (2004) provide empirical evidence that after expenses, copycat funds earned statistically indistinguishable and possibly higher returns. They argue that if investors buy actively managed funds to obtain high net-of-expenses returns, then copycat funds could potentially erode their market share by offering comparable returns net of expenses. Wang and Varbeek (2010) show that the relative success of copycat funds have improved after 2004, when the SEC increased the mandatory disclosure frequency to quarterly from semi-annual previously.

[3]There are other possible motives for confidential treatment requests, which are beyond the scope of this paper. They include manipulation (see Fishman and Hagerty (1995), and John and Narayanan (1997)) and window-dressing (see Musto (1997), and Meier and Schaumburg (2006)).

this trade. The SEC decides whether to approve this request before the manager trades in the second period. The model most similar to ours is Huddart et al. (2001). Their model is an extension of Kyle (1985) with mandatory disclosure of trades. A perfectly informed risk-neutral insider's trades include a random noise component to disguise the information-based component of the trades when they are publicly disclosed. This diminishes the market maker's ability to draw inferences on the insider's information from his disclosed trades. The insider therefore does not surrender his entire informational advantage after his first trade is disclosed. The authors term this 'trading strategy dissimulation'. Other theoretical papers with variations of this dissimulation strategy include Zhang (2004), Zhang (2008), Huang (2008) and Buffa (2010).

In our model, it follows that the manager cannot report the true fair value to the SEC and use Huddart et al. (2001)'s dissimulation strategy at the same time. According to current SEC regulatory guidelines on confidential treatment requests, the fund manager needs to detail a specific on-going investment program in his application. The trade that he wants to delay disclosure therefore needs to be coherent with the investment objective he reports to the SEC. For example, suppose the initial price of the asset before he made his first trade is 10 and he reports the true fair value of 30 to the SEC, his first trade needs to be a buy for the investment program to be coherent. Adding a dissimulation noise term in the first trade may result in a sell instead of a buy. This would result in the SEC rejecting the application.

We find that the equilibrium strategy of the manager is to dissimulate his reported estimate of the fair value to the SEC. Back to the above example, it means that he reports to the SEC a noisy signal that is a sum of the true fair value and a random normally distributed noise term. This random noise term is proportional to the unconditional variance of the fair value. Given this reported noisy signal, the manager has an estimate of the fair value, using the projection theorem of normal random variables. In the event that confidential treatment is denied, the random noise term prevents the market-maker from perfectly inferring the true fair value. Similar to Huddart et al. (2001), no invertible trading strategy can be part of a Nash equilibrium if the manager does not add noise to the true fair value. Suppose the manager reports the true fair value to the SEC. The market-maker will set a perfectly elastic price in the event that the application is rejected and the manager's trade is disclosed. The manager thus would have an incentive to deviate from reporting the true fair value, and make infinite trading profits in the second period if his application is rejected.

Besides the initial trade, we also assume that the manager's subsequent trade is coherent with the reported estimate of the fair value of the asset, in the event confidential treatment is granted. Let us suppose that the manager knows that the true fair value is 20, the estimate he reported to the SEC is 30 and the price in the first round of trading is 25. The manager is committed to buy in the second period if he is granted confidential treatment, even though he is expected to make a loss if he does so. We assume that non-compliance of the reported investment program would result in punitive costs in the form of rejections in future applications by the SEC. We believe that this assumption is reasonable as the second trade is also observable by the SEC. In addition, Agarwal et al. (2011) provide empirical evidence that past confidential treatment denial rates is the single most important predictor of future denial rates. Therefore it is important for managers to have a good filing track record as it would affect the probability of success in future applications.

Although the granting of confidential treatment prevents the market-maker from inferring the manager's signal from his trade, the commitment to the reported investment program to the SEC reduces his expected profits. This is because the manager would not be able to fully exploit his knowledge of the true fair value in the event his application for confidential treatment is granted. We find that if the probability of application success is below a certain threshold, the expected profits of the manager is lower than in a scenario where he always discloses his trades, as in Huddart et al. (2001).

To our knowledge, this is the first theoretical model that examines the impact of confidential treatment requests on the trading strategies by informed traders. The empirical literature is also relatively new as databases of institutional holdings like Thomson Reuters Ownership Data generally do not include data on confidential holdings. Agarwal et al. (2011), and Aragon et al. (2011) are two empirical studies that examine confidential treatment filings. Compared to other investment managers, hedge funds are the most aggressive applicants for confidential treatment of their trades. Both papers document that confidential holdings exhibit superior performance. The first paper also finds a significant positive market reaction after the involuntary disclosure of hedge funds' holdings due to quick rejections of confidential treatment requests by the SEC. The authors conclude that the rejections force the revelation of information that has not been reflected in the stock prices, and this may disrupt the funds' stock acquisition strategies. Their findings support the assumption in our model that confidential treatment applications are primarily for protecting private information. This is in contrast to Cao (2011) who finds evidence that investment firms with poor past trading performance use confidential treatment to hide the liquidation of stocks in their portfolio that have performed poorly. Our model assumes that the manager does not have such window-dressing motives.

The rest of this paper is structured as follows. Section 2 discusses the SEC regulatory guidelines on confidential treatment requests. Section 3 describes the model under 2 different scenarios. In the first scenario, the SEC restricts the manager's second period trade such that it is consistent with his reported forecast, in the event confidential treatment is granted. We believe that this scenario is the best depiction of current SEC regulations. We also examine the case where there is no restriction on the manager's second period trade. Comparative statics is discussed in Section 4, where we compare the model against a two-period Huddart et al. (2001) and a two-period Kyle (1985) model. Section 5 concludes.

2 SEC Regulatory Guidelines on Confidential Treatment Requests

Section 13(f) of the Securities Exchange Act of 1934 requires investment managers (who manage more than US$100 million in assets) to publicly disclose their portfolio holdings within 45 days after the end of every quarter. Section 13(f) was enacted by Congress in 1975 to allow the public to have access to the information regarding the purchase, sale and holdings of securities by institutional investors. However, the mandatory disclosure of holdings before an ongoing investment program is complete would be detrimental to the interests of the institutional investor and its fund investors. To balance these competing interests, the SEC allows institutional investors to apply for confidential treatment.

Generally, confidential treatment requests are granted if the investment manager can demonstrate that confidential treatment is in the public interest or for the protection of the investors. According to the SEC [4], there are several key criteria that the manager needs to fulfill for his confidential treatment request to be successful. Firstly, the manager needs to detail a specific investment program. He needs to provide the SEC information regarding the program's ultimate objective and describe the measures taken during that quarter toward effectuating the program. He also needs to provide information on the trades that are made in that quarter to support the existence of the program. Secondly, the investment program must be an on-going one that continues through the date of the filing. Thirdly, the manager must show that the disclosure of the fund's holdings would reveal the investment strategy to the public. Lastly, he must demonstrate that failure to grant confidential treatment to the holdings would harm the fund's performance. This would include lost profit opportunities due to mimicking strategies of other copycat investors as well as front-running activities by

[4] See http://www.sec.gov/divisions/investment/guidance/13fpt2.htm for a description of the application process for confidential treatment. These rules were introduced in 1998 to prevent investment managers to use confidential treatment requests as a tool to manipulate the market.

other market participants. If the manager's application is unsuccessful, he is required to disclose the holdings within 6 business days.

We attempt to explicitly model the above guidelines. We assume that an informed investment manager details a "a specific investment program" by submitting to the SEC his signal of the fair value of the asset. This signal can be interpreted as a target price for the manager. The manager also needs to submit a trade that he has already made in the previous quarter which is consistent with the target price. In the event he is granted confidential treatment, he has to continue trading in the subsequent period in a manner that is consistent with the original target price. This is because the investment program is an "on-going" one.

The SEC application guidelines for confidential treatment requests imply that the trades are typically large trades[5] that have huge price impact and are done over more than one quarter. The SEC receives about 60 such requests every quarter. A recent example is Berkshire Hathaway's (Warren Buffett's investment holding company) purchase of a 5.5 stake in IBM worth US$10 billion in 2011[6]. The SEC allowed the company to defer disclosure of the IBM trades by a quarter. Without confidential treatment being granted, it is likely that the purchase would be more costly.

It is noted that the granting of confidential treatment by the SEC is not a guaranteed event. In their sample of confidential treatment requests from 1999 to 2007, Agarwal et al. (2011) report that 17.4 were denied by the SEC. Even applications by well-known investors like Warren Buffett's Berkshire Hathaway have previously been rejected[7], with a 72.3 rejection rate from 65 applications. The distribution of rejection rates shows considerable

[5] In Agarwal et al. (2011)'s sample, the average confidential holding represents 1.25 of all the shares outstanding by the issuer compared to the average of 0.68 for disclosed holdings.

[6] http://dealbook.nytimes.com/2011/11/14/one-secret-buffett-gets-to-keep/

[7] See http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aNd_pTpcmBwA &refer=news_index

variation across managers.

3 Model

3.1 Set-up

This Kyle (1985)-type model employs a setting similar to the two-period model in Huddart et al. (2001). There are two trading periods indexed by $n \in \{1, 2\}$. The discount rate is normalised to zero for simplicity. There is one risky asset in the market with a liquidation value of v, where $v \sim N(P_0, \Sigma_0)$. v is realised after the second trading period. There are liquidity traders who summit exogenously generated orders u_n in each trading period, where $u_n \sim N(0, \sigma_u^2)$. We assume that u_1, u_2 and v are all mutually independent.

A risk-neutral informed investment manager observes v perfectly before trading commences. He decides to apply for confidential treatment for his first period trade before making the trade. He trades x_1 in the first period and declares to the SEC that he has a signal θ of the asset value. Let D denote the event in which the first period trade is disclosed (application is unsuccessful) and N denote the event in which the trade is not disclosed (application is successful)[8]. The application for confidential treatment is successful with a probability of α. The manager trades x_2^N (x_2^D) in the second period if the application is successful (unsuccessful).

There exists a competitive risk neutral market maker who sets prices. He cannot distinguish the trades of the manager from the other uninformed orders of the liquidity traders. He only observes the aggregate order flow y_n in each period and sets the price to be equal to the posterior expectation of v. The price is therefore semi-strong efficient and the market-maker makes zero expected profits due to Bertrand competition with potential rival market-makers.

[8]Similar to Huddart et al. (2001), since trading occurs only once for every reporting period, the disclosure of holdings is equivalent to the disclosure of trades.

In the event that the manager's first period trade is disclosed, the market-maker updates his expectation of v to P_1^* from the first period price P_1 before trading commences in the second period. Conversely, if there is no disclosure, the market-maker infers that confidential treatment has been granted.

If the manager decides to apply for confidential treatment, we show that an equilibrium exists where he declares to the SEC that he has a signal θ, where $\theta = v + \eta$, $\eta \sim N\left(0, \sigma_\eta^2\right)$, and η is distributed independently of v and u_n. η is the noise term that the manager adds to v when he applies for confidential treatment. Given θ, his reported forecast of v is v'. According to the projection theorem of normal random variables,

$$v' = P_0 + \frac{\Sigma_0}{\Sigma_0 + \sigma_\eta^2}(\theta - P_0) \tag{1}$$

As mentioned earlier, to stand any chance of getting SEC approval for confidential treatment, the manager needs to report a coherent on-going trading program. This means that his first period trade x_1 must be consistent with v'. If his application is successful, his second period trade also needs to be consistent with v' and not v. Using backward induction, this means that the manager chooses x_2^N to maximise his expected second period profits $E(\pi_2)$ as if his signal is v' instead of v. His maximisation problem is

$$x_2^N \in \arg\max_{x_2^N} E(\pi_2 | v') \tag{2}$$

Referring to the numerical example described in the introduction, we have $P_0 = 10$, $P_1 = 25$, $v = 20$ and $v' = 30$. The manager is committed to buy in the second period (since $v' > P_1$) even though he would make an expected loss in this trade (since $v < P_1$). If the application is rejected, the informed trader is forced to disclose his first period trade before trading commences in the second period. However, the informed trader is now free to make use of his knowledge of v in his second period trade x_2^D as his trading strategy is now not bounded by the confidential treatment request. In contrast to (2), the maximisation problem is now

$$x_2^D \in \arg\max_{x_2^D} E\left(\pi_2 | v\right) \tag{3}$$

We define Σ_1^N and Σ_1^D as the amount of private information that the manager can exploit in the second period of trading, in the event that confidential treatment is granted and not granted respectively

$$\Sigma_1^N = var\left(v' | y_1\right) = var\left(v' - P_1\right) \tag{4}$$

$$\Sigma_1^D = var\left(v | x_1\right) = var\left(v - v'\right) \tag{5}$$

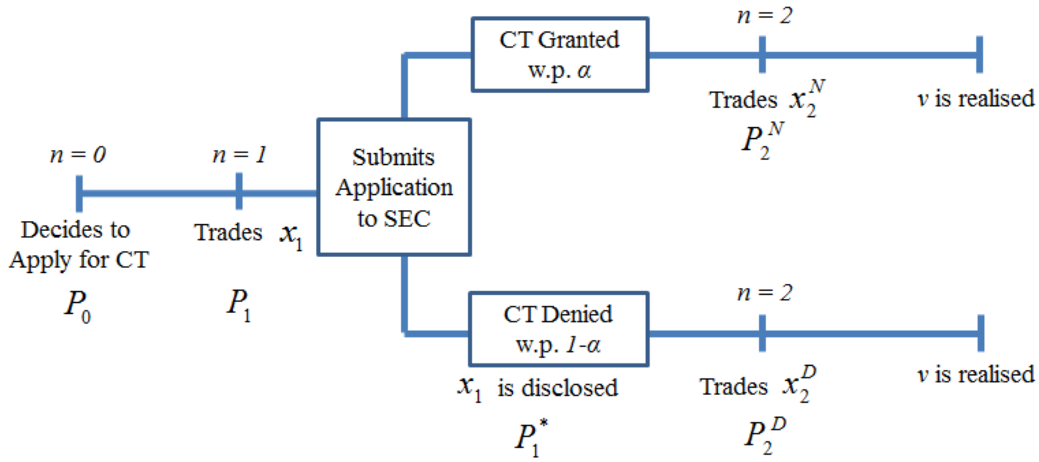

Figure 1: Timeline of events of confidential treatment request

Figure 1 shows the timeline of the model.

3.2 SEC restricts the manager's second period trade after confidential treatment is granted

Proposition 1. *If the investment manager applies for confidential treatment and the SEC restricts his second period trade in the event confidential treatment is granted, a subgame perfect linear equilibrium exists in which*

1. *The manager submits his noisy signal θ to the SEC whereby*

$$\theta = v + \eta, \eta \sim N\left(0, \sigma_\eta^2\right) \qquad \sigma_\eta^2 = h\Sigma_0$$

where $0 \leq h \leq 1$ is the only real positive root of the following equation, such that $\lambda_1 > 0$, $\lambda_2^D > 0$, $\lambda_2^N > 0$

$$\left((1-\alpha)^2 - h\right)\sqrt{(1-\alpha)^2 + h} - \alpha(1-\alpha)^2\sqrt{h} = 0$$

2. *The manager's trading strategies and expected profits are of the linear form*

$$x_1 = \beta_1 (v' - P_0)$$

$$\beta_1 = \frac{\sigma_u}{\sqrt{\Sigma_0}} \frac{\sqrt{h(1+h)}}{(1-\alpha)} \qquad \lambda_1 = \frac{\sqrt{\Sigma_0}}{\sigma_u} \frac{(1-\alpha)}{\left((1-\alpha)^2+h\right)} \sqrt{\frac{h}{1+h}}$$

$$x_2^D = \beta_2^D (v - v') \qquad \Sigma_1^D = \frac{h}{1+h}\Sigma_0$$

$$x_2^N = \beta_2^N (v' - P_1) \qquad \Sigma_1^N = \frac{(1-\alpha)^2}{(1+h)\left((1-\alpha)^2+h\right)}\Sigma_0$$

$$\beta_2^D = \frac{\sigma_u}{\sqrt{\Sigma_1^D}} \qquad \lambda_2^D = \frac{\sqrt{\Sigma_1^D}}{2\sigma_u}$$

$$\beta_2^N = \frac{\sigma_u}{\sqrt{\Sigma_1^N}} \qquad \lambda_2^N = \frac{\sqrt{\Sigma_1^N}}{2\sigma_u}$$

$$E(\pi_1) = \frac{\beta_1(1-\lambda_1\beta_1)\Sigma_0}{1+h}$$

$$E\left(\pi_2^N\right) = \frac{\sigma_u\sqrt{\Sigma_1^N}}{2} \qquad E\left(\pi_2^D\right) = \frac{\sigma_u\sqrt{\Sigma_1^D}}{2}$$

3. *The market-maker's pricing rule is of the linear form*

$$P_1 = P_0 + \lambda_1 y_1$$

$$P_1^* = v'$$

$$P_2^D = v' + \lambda_2^D y_2^D$$

$$P_2^N = P_1 + \lambda_2^N y_2^N$$

Proof: See Appendix

The main intuition of the proof is as follows. After computing x_2^N and x_2^D, by backward induction, we derive the total expected profits in both periods and then take the first order condition with respect to x_1. The first order condition equation will be in terms of $v - P_0$ and x_1. Following from Huddart et al. (2001), for the mixed strategy $\theta = v + \eta$, $\eta \sim N\left(0, \sigma_\eta^2\right)$ to hold in equilibrium, the manager must be different across all values of x_1, as x_1 is a function of θ. The coefficients of $v - P_0$ and x_1 must therefore be zero, resulting in two simultaneous equations. The other parameters can then be solved.

The variance of the noise σ_η^2 that the manager adds to the forecast he submits to the SEC is directly proportional to the unconditional variance of the fair value Σ_0. In the event that confidential treatment is granted, the second period trade $x_2^N = \beta_2^N \left(v' - P_1\right)$ is a linear function of v', in spite of the manager knowing that the true fair value is v. On the other hand, if the confidential treatment request is denied, the manager's second period trade is $x_2^D = \beta_2^D \left(v - v'\right)$ as the manager is now free to make use of his knowledge of v.

The market-maker is able to infer v' perfectly from x_1 because x_1 is a linear function of $v' - P_0$. He updates his expectation of v to $P_1^* = v'$ from P_1 before trading commences in the second period.

3.3 SEC does not restrict the manager's second period trade

In the next proposition, we will examine the manager's equilibrium trading strategy if the SEC does not restrict his second period trade when confidential treatment is granted. The manager is free to use his knowledge of v in his second period trade. We add an upper hat to the endogenous parameters in this equilibrium to distinguish them from those in Proposition 1. Therefore in contrast to (2), the manager's maximisation problem in the second period when confidential treatment is granted is

$$\widehat{x}_2^N \in \arg\max_{\widehat{x}_2^N} E\left(\widehat{\pi}_2|v\right) \tag{6}$$

Proposition 2. *If the investment manager applies for confidential treatment and the SEC does not restrict his second period trade, a subgame perfect linear equilibrium exists in which*

1. *The manager submits his noisy forecast* $\widehat{\theta}$ *to the SEC whereby*

$$\widehat{\theta} = v + \widehat{\eta}, \widehat{\eta} \sim N\left(0, \widehat{\sigma}_\eta^2\right) \qquad \widehat{\sigma}_\eta^2 = g\Sigma_0$$

where $0 \le g \le 1$ *is the only real positive root of the following equation, such that* $\widehat{\lambda}_1 > 0$, $\widehat{\lambda}_2^D > 0$, $\widehat{\lambda}_2^N > 0$

$$\alpha\sqrt{\frac{g}{g+1}} - (1-\alpha)\left(g^{2/3}(1-\alpha)^{-4/3} - 1\right)\sqrt{\frac{\frac{g^{2/3}}{1+g}(1-\alpha)^{2/3}+1}{g^{-1/3}(1-\alpha)^{2/3}+1}} = 0$$

2. *The manager's trading strategies and expected profits are of the linear form*

$$\widehat{x}_1 = \widehat{\beta}_1\left(\widehat{v}' - P_0\right)$$

$$\widehat{\beta}_1 = \frac{\sigma_u}{\sqrt{\Sigma_0}}\left(\frac{1-\alpha}{\sqrt{g}}\right)^{1/3}\sqrt{1+g} \qquad \widehat{\lambda}_1 = \frac{\sqrt{\Sigma_0}(1-\alpha)}{\sigma_u\left(\frac{1-\alpha}{\sqrt{g}}\right)^{1/3}\left(g^{1/3}(1-\alpha)^{1/3}+1-\alpha\right)\sqrt{1+g}}$$

$$\widehat{x}_2^D = \widehat{\beta}_2^D\left(v - \widehat{v}'\right) \qquad \widehat{\Sigma}_1^D = \frac{g}{1+g}\Sigma_0$$

$$\widehat{x}_2^N = \widehat{\beta}_2^N\left(v - \widehat{P}_1\right) \qquad \widehat{\Sigma}_1^N = \frac{\frac{g}{1+g}\left(\frac{1-\alpha}{\sqrt{g}}\right)^{2/3}+1}{\left(\frac{1-\alpha}{\sqrt{g}}\right)^{2/3}+1}\Sigma_0$$

$$\widehat{\beta}_2^D = \frac{\sigma_u}{\sqrt{\widehat{\Sigma}_1^D}} \qquad \widehat{\lambda}_2^D = \frac{\sqrt{\widehat{\Sigma}_1^D}}{2\sigma_u}$$

$$\widehat{\beta}_2^N = \frac{\sigma_u}{\sqrt{\widehat{\Sigma}_1^N}} \qquad \widehat{\lambda}_2^N = \frac{\sqrt{\widehat{\Sigma}_1^N}}{2\sigma_u}$$

$$E\left(\widehat{\pi}_1\right) = \frac{\widehat{\beta}_1\left(1-\widehat{\lambda}_1\widehat{\beta}_1\right)\Sigma_0}{1+g}$$

$$E\left(\widehat{\pi}_2^N\right) = \frac{\sigma_u\sqrt{\widehat{\Sigma}_1^N}}{2} \qquad E\left(\widehat{\pi}_2^D\right) = \frac{\sigma_u\sqrt{\widehat{\Sigma}_1^D}}{2}$$

3. *The market-maker's pricing rule is of the linear form*

$$\widehat{P}_1 = P_0 + \widehat{\lambda}_1\widehat{y}_1$$

$$\widehat{P}_1^* = \widehat{v}'$$

$$\widehat{P}_2^D = \widehat{v}' + \widehat{\lambda}_2^D\widehat{y}_2^D$$

$$\widehat{P}_2^N = \widehat{P}_1 + \widehat{\lambda}_2^N\widehat{y}_2^N$$

Proof: See Appendix

Since the manager is free to use his knowledge of v, his second period trade given confidential treatment is $\widehat{x}_2^N = \widehat{\beta}_2^N \left(v - \widehat{P}_1\right)$ instead of $\widehat{\beta}_2^N \left(v' - \widehat{P}_1\right)$. Similar to the result in Proposition 1, the variance of the noise $\widehat{\sigma}_\eta^2$ that the manager adds to the forecast he submits to the SEC is also directly proportional to the unconditional variance of the fair value Σ_0.

Corollary 1. *Under both scenarios in Propositions 1 and 2, a) if $\alpha = 0$, the equilibrium is equivalent to a two-period Huddart et al. (2001) model; b) if $\alpha = 1$, the equilibrium is equivalent to a two-period Kyle (1985) model.*

If $\alpha = 0$, the manager has no chance of getting confidential treatment. Therefore he always discloses his first period trade and this is equivalent to a two-period Huddart et. al (2001) model. The manager adds η to v when he reports his signal to the SEC, where $\sigma_\eta^2 = \Sigma_0$. The manager's first period of trade has the same amount of dissimulation as in a two-period Huddart et al. (2001) model[9]. Similarly, if $\alpha = 1$, the manager is always successful in getting confidential treatment. His first period trade is $x_1 = \beta_1 (v - P_0)$ and he reports $\theta = v$ to the SEC. His second period is $x_2 = \beta_2^N (v - P_1)$ as this is consistent with his reported signal v to the SEC. This scenario is thus equivalent to a two-period Kyle (1985) model.

4 Comparative Statics

In this section, we will focus on analysing the parameters in Proposition 1 and 2. We first compare the total expected profits against those that the manager is expected to receive if he always discloses his initial trade.

[9]The first period trade in a two-period Huddart et al. (2001) model is $\overline{x}_1 = \overline{\beta}_1 (v - P_0) + \overline{z}_1$, where $\overline{z}_1$ is the dissimulation term that has a variance of $\frac{\sigma_u^2}{2}$. In Proposition 1, the first period trade can be expressed as $x_1 = \frac{\beta_1 \Sigma_0}{\Sigma_0 + \sigma_\eta^2} (v - P_0) + \frac{\beta_1 \Sigma_0}{\Sigma_0 + \sigma_\eta^2} \eta$. It follows that if $\sigma_\eta^2 = \Sigma_0$, the equilibrium in Proposition 1 is equivalent to Huddart et al. (2001)'s. The same applies for Proposition 2 too.

4.1 Manager's Profits

Proposition 3. *Compared with the expected profits where the manager always discloses his initial trade (as in Huddart et al. (2001)), a) if the SEC restricts the second period trade in the event confidential treatment is granted, the manager's expected profits will be lower if* $0 \leq \alpha \leq \alpha^*$*, where* $\alpha^* \approx 0.361$*; b) if the SEC does not restrict the second period trade, the manager's expected profits will be always higher for* $0 \leq \alpha \leq 1$

Proof: See Appendix

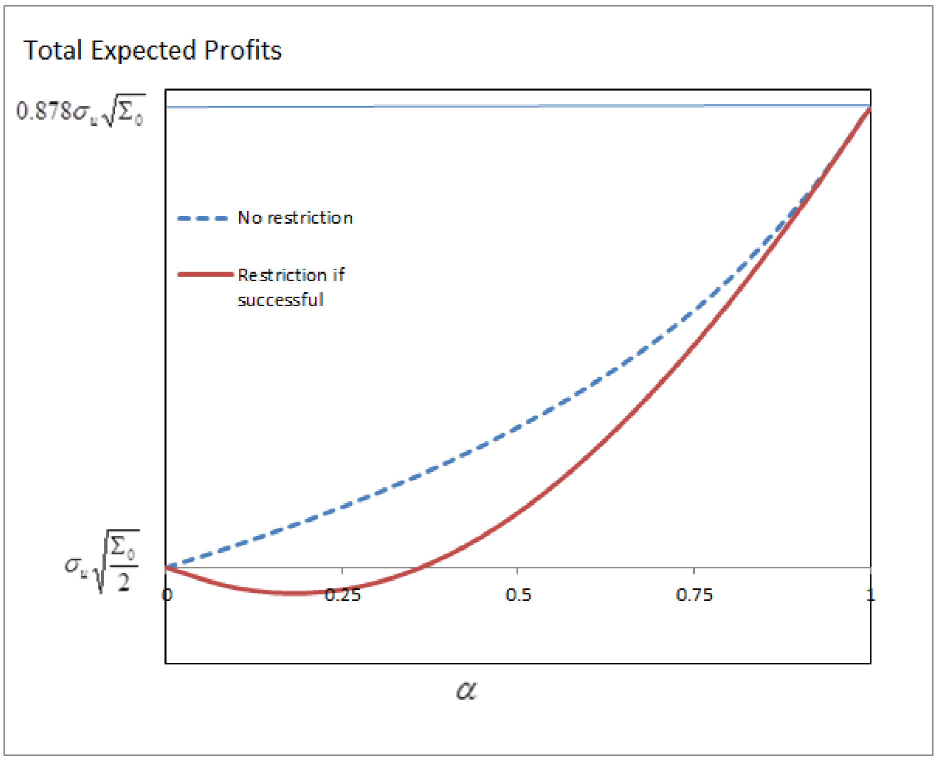

Figure 2: Total expected profits of manager under the 2 different assumptions

Fig 2 shows the total expected profits (over the two periods) of the manager when he applies for confidential treatment, under the scenarios in Propositions 1 and 2. The total expected profits under the two-period Huddart et al. (2001) equilibrium is $\sigma_u\sqrt{\frac{\Sigma_0}{2}}$, while those of a two-period Kyle (1985)[10] is approximately $0.878\sigma_u\sqrt{\Sigma_0}$. As discussed in Corollary

[10]See Huddart et al. (2001). The paper's Proposition 2 shows the expected profits of a two-period Huddart

	Restriction in second period trade if confidential treatment is granted	No restriction in second period trade
$E(\pi_1)$	Always Higher	Always Higher
$E(\pi_2)$	Lower for $0 \leq \alpha \leq 0.854$	Always Higher
$E(\pi_2^N)$	Lower for $0 \leq \alpha \leq 0.485$	Always Higher
$E(\pi_2^D)$	Always Lower	Always Lower
$E(\pi_1)+E(\pi_2)$	Lower for $0 \leq \alpha \leq 0.361$	Always Higher

Figure 3: Comparison of expected profits with tTwo-period Huddart et al. (2001) model

1, the equilibrium under both scenarios is equivalent to a two-period Huddart et al. (2001) model if $\alpha = 0$, and a two-period Kyle (1985) model if $\alpha = 1$. For all values of α between 0 and 1, the total expected profits in the equilibrium with no second period trade restriction is higher than $\sigma_u\sqrt{\frac{\Sigma_0}{2}}$. On the other hand, in the equilibrium with the second period trade restriction, the total expected profits are lower than $\sigma_u\sqrt{\frac{\Sigma_0}{2}}$ for $0 \leq \alpha \leq \alpha^*$.

To understand why the manager might have lower expected profits if he applies for confidential treatment in the scenario in Proposition 1, let us examine the expected profits in both periods separately. Figure 3 shows the comparison of the expected profits of the manager in the scenarios of Proposition 1 and 2 against those of a two-period Huddart et al. (2001) model, where the insider always discloses his first trade. In their model, the informed insider earns the same expected profits $\frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$ in both periods. In our model under both scenarios, the manager always earns higher expected profits in the first period, i.e. $E(\pi_1) \geq \frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$ and $E(\widehat{\pi}_1) \geq \frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$. This is because both σ_η^2 and $\widehat{\sigma}_\eta^2$ are less than Σ_0, implying that the manager is more aggressive in exploiting his information in the first period. In the second period, in the event that confidential treatment is denied, the disclosure of the first period trade results in both $E\left(\pi_2^D\right)$ and $E\left(\widehat{\pi}_2^D\right)$ to be lower than $\frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$. This is because the market-maker updates the price to reflect the information contained in the

et al. (2001) dissimulation equilibrium, while Proposition 1 shows the expected profits in a two-period Kyle (1985) model. Note that there is a typo in Proposition 1: $E(\pi_1) = \frac{\sqrt{2K(K-1)}}{4K-1}\sigma_u\sqrt{\Sigma_0}$ instead of $E(\pi_1) = \frac{2K(K-1)}{(4K-1)^2}\sigma_u\sqrt{\Sigma_0}$.

disclosed trade, reducing the information advantage that the manager can exploit in the second period.

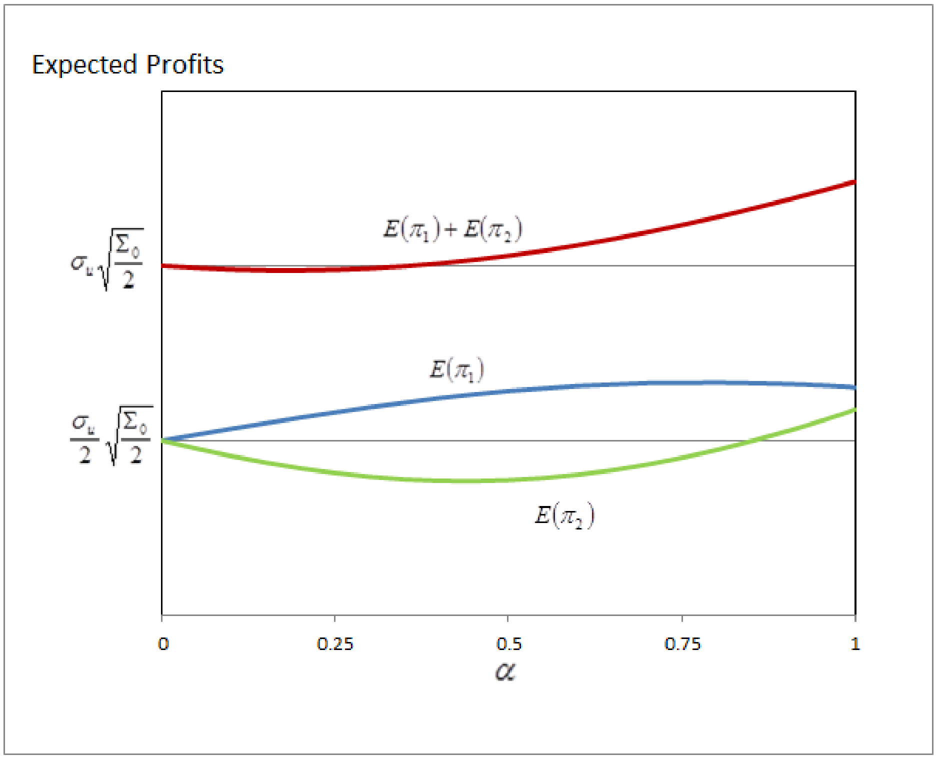

Figure 4: Expected profits of manager in the 2 trading periods under the assumption that the SEC restricts the second period trade if confidential treatment request is successful

The comparison results diverge in the event that confidential treatment is granted. We find that $E\left(\widehat{\pi}_2^N\right) \geq \frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$for all values of α between 0 and 1, while $E\left(\pi_2^N\right) \leq \frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$ for $0 \leq \alpha \leq 0.485$. Under the scenario in Proposition 1, the manager is only able to trade based on his knowledge of v' instead of v. His information advantage in the second period is therefore reduced with this restriction. The reduction in expected profits in $E\left(\pi_2^N\right)$ causes $E\left(\pi_2\right) \leq \frac{\sigma_u}{2}\sqrt{\frac{\Sigma_0}{2}}$ for $0 \leq \alpha \leq 0.854$. Figure 4 shows the breakdown in the expected profits of the manager in Proposition 1 graphically.

As discussed earlier, Σ_1^D and Σ_1^N measure the amount of private information that the manager can exploit in the second period of trading. These parameters are related to the second period expected profits since $E\left(\pi_2^D\right) = \frac{\sigma_u\sqrt{\Sigma_1^D}}{2}$ and $E\left(\pi_2^N\right) = \frac{\sigma_u\sqrt{\Sigma_1^N}}{2}$. It appears that Σ_1^N should always be greater than Σ_1^D since disclosing the first period trade will result in a loss in the information advantage of the manager. However, if confidential treatment is not granted, the manager can make use of his knowledge of v, while if it is granted, he can only exploit his knowledge of v'. Figure 5 shows the relationship between Σ_1^D, Σ_1^N and $E(\Sigma_1) = \alpha\Sigma_1^N + (1-\alpha)\Sigma_1^D$ with α. Interestingly, we find that $\Sigma_1^D > \Sigma_1^N$ for $0 \le \alpha \le 0.209$. In contrast, in the scenario where the SEC does not restrict the manager's second period trade, we find that $\widehat{\Sigma}_1^D < \widehat{\Sigma}_1^N$ for all values of α between 0 and 1. This is shown in Figure 5.

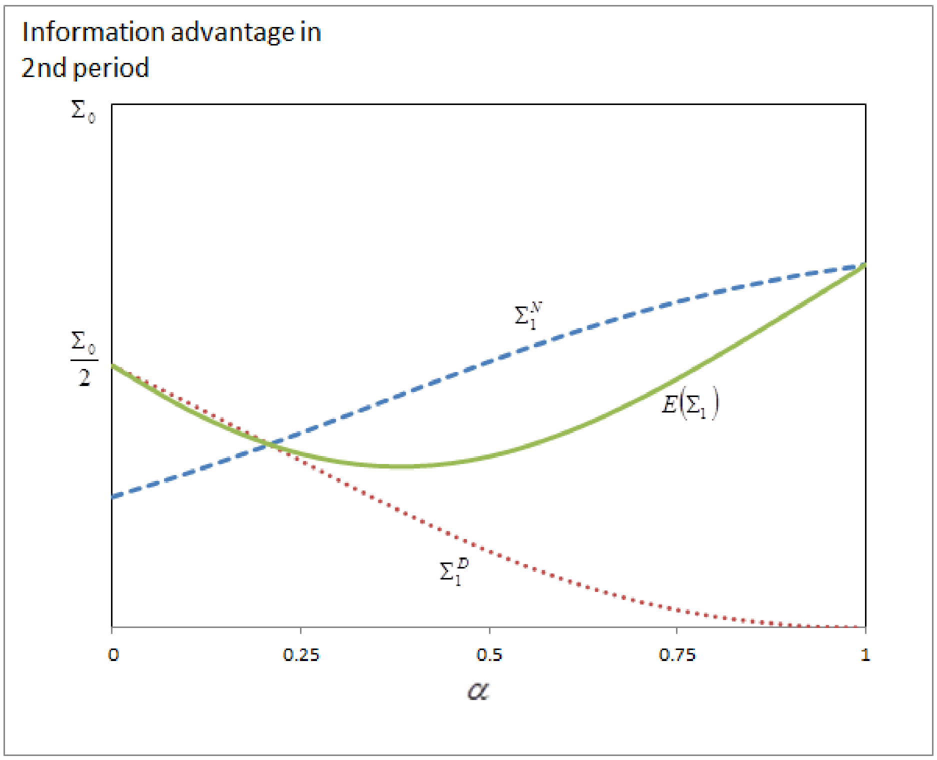

Figure 5: Information advantage of manager in the 2nd period under the assumption that the SEC restricts the second period trade if confidential treatment request is successful

4.2 Noise Added to Reported Forecast to the SEC

Corollary 2. *a) Under both scenarios in Propositions 1 and 2, the manager adds less noise to his reported forecast to the SEC as α increases. b) The manager adds less noise in the*

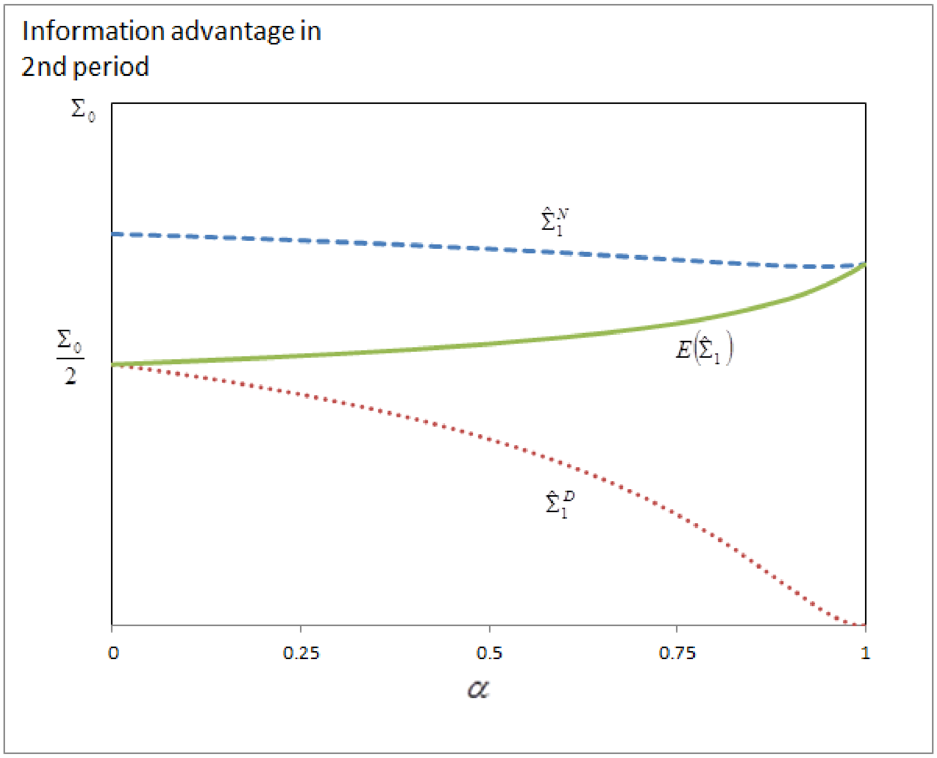

Figure 6: Information advantage of manager in the 2nd period under the assumption that the SEC does not restrict the second period trade

equilibrium in Proposition 1 compared to that in Proposition 2.

Figure 7 shows the relationship between α and the noise that the manager adds to the forecast that he submits to the SEC. As α increases, the manager adds less noise to the forecast, i.e. both $\frac{d\sigma_\eta^2}{d\alpha}$ and $\frac{d\widehat{\sigma}_\eta^2}{d\alpha}$ are negative. This is because adding more noise in the forecast would be more beneficial to the manager ex-post, in the event that his application is rejected. If $\alpha = 1$, the equilibrium is a two-period Kyle (1985) model where there is no noise (the manager reports the true fair value of v to the SEC), while if $\alpha = 0$, the equilibrium is a two-period Huddart et al. (2001) model where the noise term is Σ_0 . In addition, we note that $\sigma_\eta^2 \leq \widehat{\sigma}_\eta^2$ for all values of α between 0 and 1. Adding more noise to the forecast would result in a v' that varies more from the true fair value v. If the SEC forces the manager to trade based on the reported v' in the event that confidential treatment is granted, the

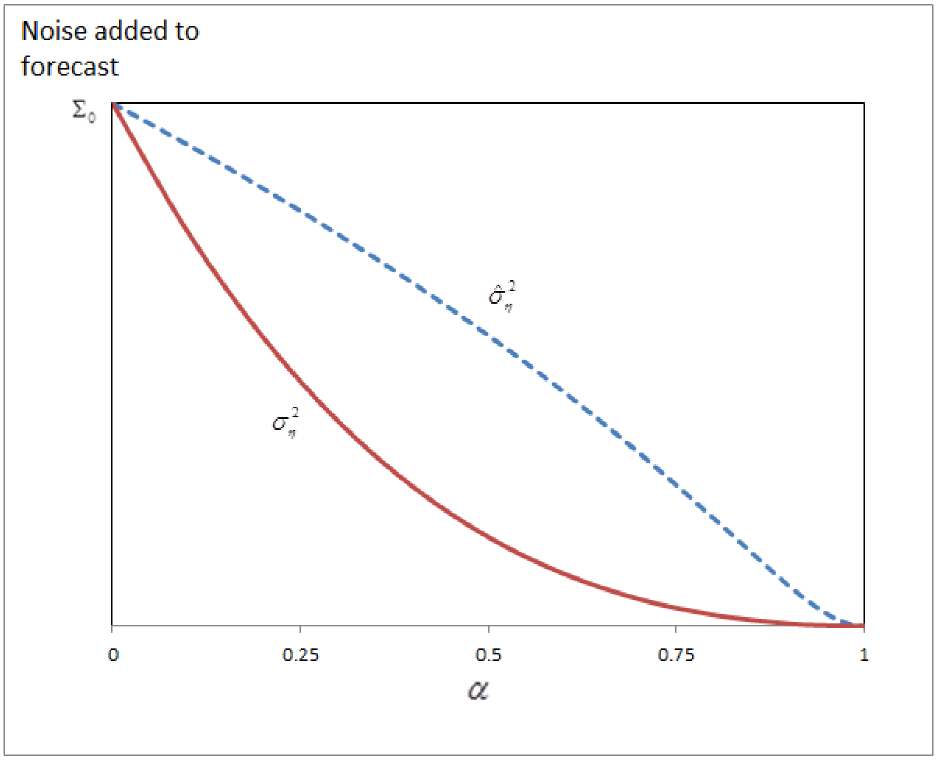

Figure 7: Noise added to the forecast by manager in his confidential treatment request under the 2 different assumptions

manager would forgo substantial trading profits if he adds too much noise in his application in the first period. The restriction on the second period trade therefore forces the manager to be more truthful in the forecast that he submits to the SEC.

4.3 Price Impact of Disclosed Trade

Upon facing a rejection of the confidential treatment request, the manager needs to disclose his first period trade. The market-maker updates the price from P_1 to $P_1^* = v'$ before trading commences in the second period. The price impact of the disclosed trade is

$$E\left(\frac{v' - P_1}{x_1}\right) = \frac{1}{\beta_1} - \lambda_1 \tag{7}$$

The first period trade x_1 thus has a price impact of λ_1 on P_1 and another price impact of $\frac{1}{\beta_1} - \lambda_1$ when it is disclosed. Following from Proposition 2 in Huddart et al. (2001), if the manager does not apply for confidential treatment, the corresponding price impact of the disclosed trade is $\frac{1}{2\sigma_u}\sqrt{\frac{\Sigma_0}{2}}$.

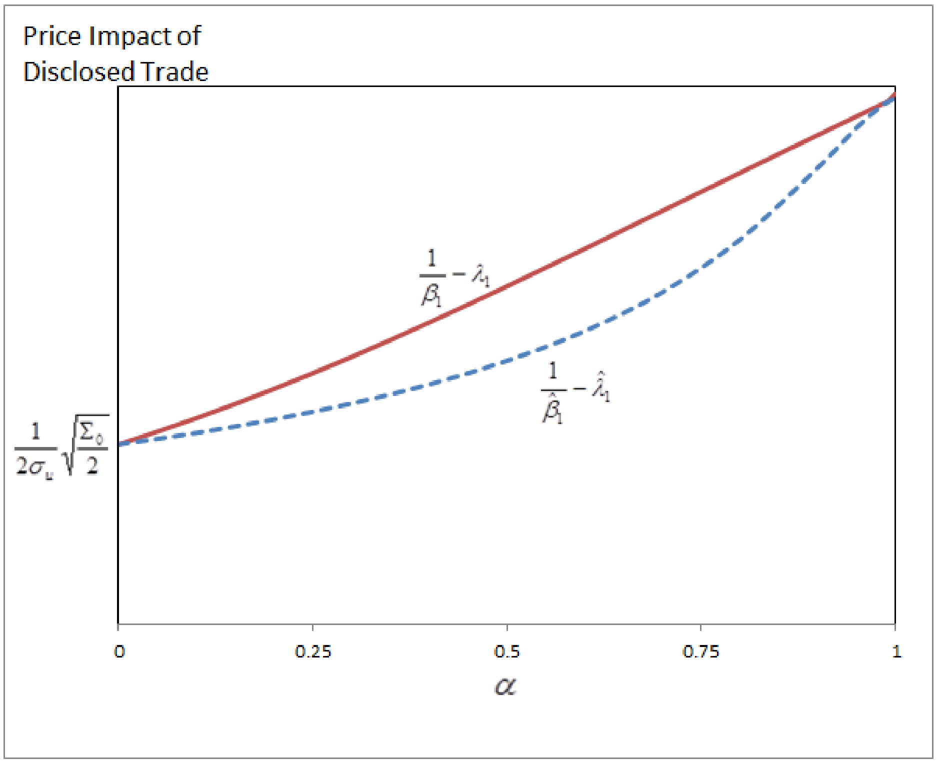

Figure 8: Price impact if manager's trade is disclosed due to unsuccessful confidential treatment request under the 2 different assumptions

Figure 8 depicts the positive relationship between the price impact of the disclosed trade and α. The price impact due to a confidential treatment request denial is greater than that of a voluntarily disclosed trade (where $\alpha = 0$). If managers with a better market reputation of uncovering the fair value of stocks like Warren Buffett are assigned a higher α, then it follows that their disclosed trades due to confidential treatment denials will result in a larger price impact. In addition, we note that the price impact under the scenario where the SEC restricts the second period trade is greater than the price impact under the scenario where there are no restrictions, i.e. $\frac{1}{\beta_1} - \lambda_1 \geq \frac{1}{\widehat{\beta}_1} - \widehat{\lambda}_1$. This follows from Figure 7, as the manager adds less noise under the first scenario and therefore the disclosed trade is more informative.

Agarwal et al. (2011) document a significant positive market reaction associated with involuntary disclosure of positions due to relatively quick confidential treatment denials[11] by the SEC. The authors attribute the market reaction as evidence supporting the private information motive of confidential treatment requests. The results of our model imply that the market reaction would be greater for managers with higher α.

4.4 Liquidity

We next examine the welfare implications of liquidity traders if the manager applies for confidential treatment. Compared to the case where the manager always discloses his initial trade, confidential treatment implies greater information asymmetry between the manager and the market maker. We would expect greater transaction costs for liquidity traders as market depth decreases. Figure 9 depicts the relationship between α and the market-maker's liquidity parameters in Proposition 1. In the two-period Huddart et al. (2001) model, $\overline{\lambda}_1 = \overline{\lambda}_2 = \frac{1}{2\sigma_u}\sqrt{\frac{\Sigma_0}{2}}$. Since the liquidity parameters in the second period λ_2^N and λ_2^D are different and liquidity traders by definition cannot choose when they can trade, we compute the expected value of the liquidity parameter in the second period: $E(\lambda_2) = \alpha\lambda_2^N + (1-\alpha)\lambda_2^D$. It can be seen that $\lambda_1 \geq \frac{1}{2\sigma_u}\sqrt{\frac{\Sigma_0}{2}}$ for all values of α, while that is not true for $E(\lambda_2)$. However the average liquidity parameter $\frac{\lambda_1 + E(\lambda_2)}{2}$ over the two periods is greater than $\frac{1}{2\sigma_u}\sqrt{\frac{\Sigma_0}{2}}$ for $\alpha \geq \alpha^*$. We therefore conclude that liquidity traders are worse off if the investment manager applies for confidential treatment. We also arrive at the same conclusion when there is no restriction in the second period trade by the SEC, as shown in Figure 10. In this scenario, even $E\left(\widehat{\lambda}_2\right)$ is greater than $\frac{1}{2\sigma_u}\sqrt{\frac{\Sigma_0}{2}}$.

[11] They classify these quick denials as filings that are denied within 45-180 days after the quarter-end portfolio date.

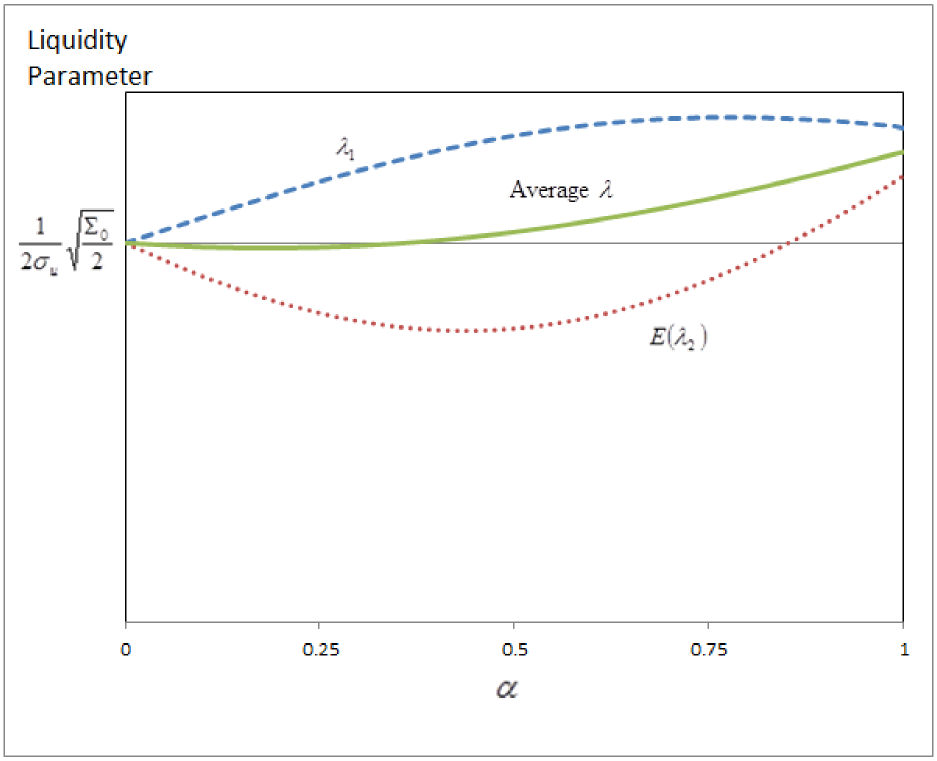

Figure 9: Liquidity parameter under the assumption that the SEC restricts the second period trade if confidential treatment request is successful

4.5 Potential Policy Change

Under current SEC policy, the manager needs to make the initial trade before he submits his confidential treatment request, to prove that the trade is part of an ongoing trading program. As discussed earlier, the manager faces the risk that the application is rejected and the trade is disclosed. A potential policy change that increases the manager's welfare would be for him to apply for confidential treatment and the SEC making the decision on the request before trading commences. Similar to the scenario in Proposition 2 where there is no restriction on the manager's second period trade, he would always apply for confidential treatment. The manager would be in a two-period Kyle (1985) equilibrium with probability α, and Huddart et. al (2001) equilibrium with probability $1 - \alpha$. The manager's profit functions under both scenarios in Propositions 1 and 2 are convex in α (see Figure 2 for $0 \leq \alpha \leq 1$. This is

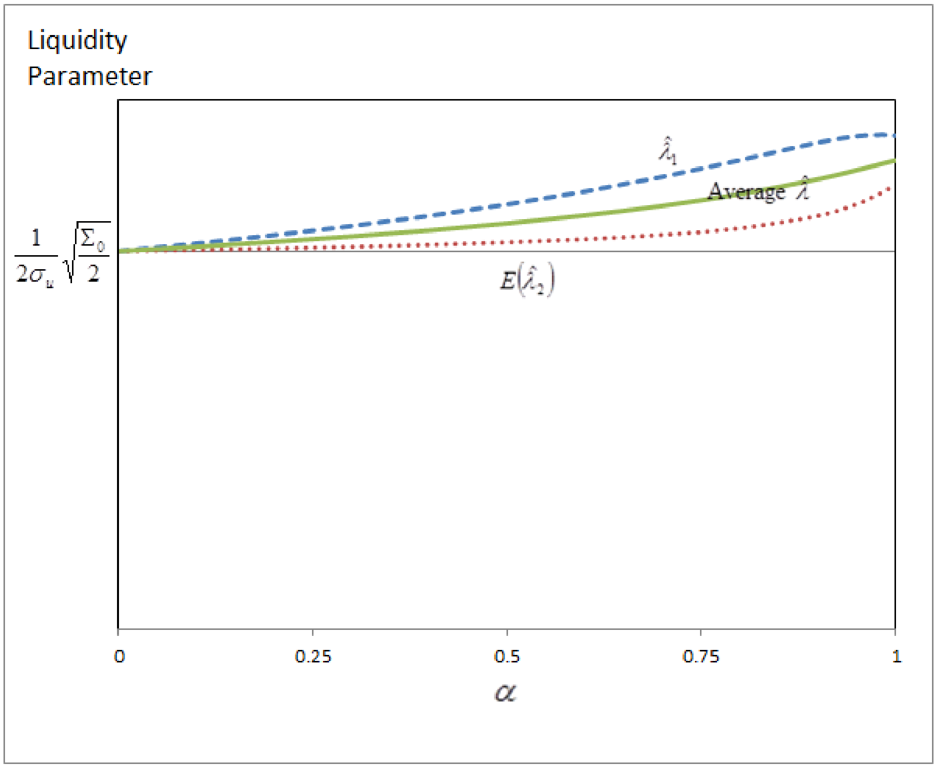

Figure 10: Liquidity parameter under the assumption that the SEC does not restrict the second period trade

because in the event of a successful application, he does not forgo any expected profits by adding noise in the initial trade, unlike the earlier scenarios. Therefore the manager would be better off with this change in policy. Correspondingly, expected liquidity falls and noise traders are worse off.

5 Conclusion

Our primary contribution is a theoretical model which describes market microstructure with confidential treatment requests of trades by investment managers. These trades are typically large ones that have huge price impact and are done over more than one quarter. The key feature we capture is that the SEC requires the manager to present a coherent on-going trading program in his application for confidential treatment. In the event his confidential treatment request is granted, he has to trade in a manner consistent with his reported forecast in the subsequent period. We assume that failure to do so would result in future rejections by the SEC and model this as an exogenous restriction in the manager's second period trade. Analogous to Huddart et al. (2001)'s dissimulation trading strategy, in equilibrium, the manager adds noise to the forecast that he reports to the SEC.

Our model explains various stylized facts described in the empirical literature. Although all investors can apply for confidential treatment, not everybody does. Furthermore, when they do apply, they are not always successful. Our model predicts that with the SEC restriction in the second period, managers only earn higher expected profits if their probability of successful application is higher than a certain threshold. If there is no such restriction, expected profits would always be higher. This is consistent with managers having heterogeneous probabilities of success. For instance, funds that employ quantitative and statistical arbitrage trading strategies involving multiple assets may find it more difficult to convince the SEC that disclosure would reveal the trading strategy to the public and harm its performance[12]. This is because the SEC will only grant confidential treatment on a position-by-position basis. In addition, Agarwal et al. (2011) report that hedge funds with higher past rejection rates are more likely to be rejected again in future applications which supports the assertion that the probability of success is a fund characteristic.

Aragon et al. (2011) and Agarwal et al. (2011) both find confidential holdings of hedge funds yield superior performance. In our model, trading after a successful application has higher expected profits whenever managers find it ex ante optimal to apply. Agarwal et al. (2011) further report a significant positive market reaction after the involuntary disclosure of hedge funds' trades following rejections of confidential treatment requests. We also find that

[12]See http://sec.gov/rules/other/34-52134.pdf. It is a rejection letter issued by the SEC on Two Sigma Investments LLC confidential treatment request in 2005. The fund uses trading strategies based on statistical models. In another case, D.E. Shaw & Company, a large quant-oriented hedge fund manager filed for confidential treatment for its entire second quarter portfolio in 2007. Their request was rejected and they were forced to disclose their whole portfolio valued at US$79 billion.

in our model. The noise that the manager adds to the first period trade successfully obscures some of his private information which can be exploited in the second period. However, a failed application reveals this information and prices react accordingly.

Finally, we examine the impact of confidential treatment provisions on market liquidity and the welfare of liquidity traders. We find that market depth is lower when the manager applies for confidential treatment. Liquidity traders will be worse off.

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6 Appendix

Proof of Proposition 1. If the application is not successful, his first period trade will be disclosed. The market-maker observes x_1 and is able to infer v' perfectly. The price of asset will be adjusted to v' before the second round of trading commences. Assume that

$$x_2^D = \beta_2^D \left(v - v'\right) \tag{8}$$

$$P_2^D = v' + \lambda_2^D y_2^D$$

If the application is successful, his first period trade will not be disclosed. Assume that

$$x_2^N = \beta_2^N \left(v' - P_1\right) \tag{9}$$

$$P_2^N = P_1 + \lambda_2^N y_2^N$$

The model is solved by backward induction. Let us first analyse the scenario in which the application is not successful and the informed trader is forced to disclose his first period trade. The informed trader maximises second period profits

$$E\left[\left(v - P_2^D\right) x_2^D | v\right] = E\left[\left(v - v' - \lambda_2^D x_2^D\right) x_2^D\right]$$

Taking first order condition with respect to x_2^D results in the following equations

$$\begin{aligned} x_2^D &= \frac{1}{2\lambda_2^D}\left(v - v'\right) \\ \beta_2^D &= \frac{1}{2\lambda_2^D} \\ E\left[\pi_2^D\left(v', v\right)\right] &= \frac{1}{4\lambda_2^D}\left(v - v'\right)^2 \end{aligned} \tag{10}$$

In the event that the application is successful, the informed trader has to choose x_2^N that is coherent with v'. This means that x_2^N is chosen such that it maximises second period profits as if the informed trader has a signal v'.

$$E\left[\left(v - P_2^N\right) x_2^N | v'\right] = E\left[\left(v' - P_1 - \lambda_2^N x_2^N\right) x_2^N\right]$$

Taking first order condition with respect to x_2^N

$$\begin{aligned} x_2^N &= \frac{1}{2\lambda_2^N}\left(v' - P_1\right) \\ \beta_2^N &= \frac{1}{2\lambda_2^N} \end{aligned} \tag{11}$$

Since the informed trader knows v instead of v', the expected profits in the second period when confidential treatment is granted is

$$E\left[\pi_2^N\left(P_1,v'\right)|v\right]=E\left[\left(v-P_2^N\right)x_2^N|v\right]=\frac{1}{2\lambda_2^N}\left(v-\frac{v'}{2}-\frac{P_1}{2}\right)\left(v'-P_1\right)$$

Stepping back to the first period, the total expected profits in both periods is

$$\begin{aligned}&E\left[\left(v-P_1\right)x_1+\left(1-\alpha\right)\pi_2^D\left(v',v\right)+\alpha\pi_2^N\left(P_1,v'\right)|v\right]\\ =\;&E\left[\begin{array}{c}\left(v-P_0-\lambda_1x_1\right)x_1+\frac{1-\alpha}{4\lambda_2^D}\left(v-P_0-\frac{x_1}{\beta_1}\right)^2\\ +\frac{\alpha}{2\lambda_2^N}\left(v-P_0-\frac{x_1}{2\beta_1}-\frac{\lambda_1x_1}{2}\right)\left(\frac{x_1}{\beta_1}-\lambda_1x_1\right)\end{array}\right]\end{aligned}$$

Taking first order condition with respect to x_1

$$\left(v-P_0\right)\left(1-\frac{1-\alpha}{2\lambda_2^D\beta_1}+\frac{\alpha}{2\lambda_2^N}\left(\frac{1}{\beta_1}-\lambda_1\right)\right)+x_1\left(-2\lambda_1+\frac{1-\alpha}{2\lambda_2^D\beta_1^2}-\frac{\alpha}{2\lambda_2^N}\left(\frac{1}{\beta_1^2}-\lambda_1^2\right)\right)=0$$

The second-order condition is

$$-2\lambda_1+\frac{1-\alpha}{2\lambda_2^D\beta_1^2}-\frac{\alpha}{2\lambda_2^N}\left(\frac{1}{\beta_1^2}-\lambda_1^2\right)\leq 0$$

Following from Huddart et al. (2001), for the mixed strategy $\theta=v+\eta$, $\eta\sim N\left(0,\sigma_\eta^2\right)$ to hold in equilibrium, the manager must be indifferent across all values of x_1, as x_1 is a function of θ. We seek positive values of λ_1, λ_2^D and λ_2^N such that

$$1-\frac{1-\alpha}{2\lambda_2^D\beta_1}+\frac{\alpha}{2\lambda_2^N}\left(\frac{1}{\beta_1}-\lambda_1\right)=0$$

and

$$-2\lambda_1+\frac{1-\alpha}{2\lambda_2^D\beta_1^2}-\frac{\alpha}{2\lambda_2^N}\left(\frac{1}{\beta_1^2}-\lambda_1^2\right)=0$$

Re-arranging terms,

$$\beta_1 = \frac{1}{\lambda_1} - \frac{1-\alpha}{2\lambda_2^D} \tag{12}$$

and

$$\beta_1 = \frac{2\lambda_2^N - \alpha\lambda_1}{\lambda_1 \left(4\lambda_2^N - \alpha\lambda_1\right)} \tag{13}$$

Using the projection theorem of normal random variables on y_1, y_2^N and y_2^D, we obtain

$$\lambda_1 = \frac{\frac{\beta_1 \Sigma_0^2}{\Sigma_0 + \sigma_\eta^2}}{\frac{\beta_1^2 \Sigma_0^2}{\Sigma_0 + \sigma_\eta^2} + \sigma_u^2} \tag{14}$$

$$\Sigma_1^D = \frac{\sigma_\eta^2}{\Sigma_0 + \sigma_\eta^2}\Sigma_0 \tag{15}$$

$$\Sigma_1^N = \frac{\Sigma_0^2}{\Sigma_0 + \sigma_\eta^2} - \frac{\left(\frac{\beta_1 \Sigma_0^2}{\Sigma_0 + \sigma_\eta^2}\right)^2}{\frac{\beta_1^2 \Sigma_0^2}{\Sigma_0 + \sigma_\eta^2} + \sigma_u^2} \tag{16}$$

$$\lambda_2^D = \frac{\beta_2^D \Sigma_1^D}{\beta_2^{D2} \Sigma_1^D + \sigma_u^2} \tag{17}$$

$$\lambda_2^N = \frac{\beta_2^N \Sigma_1^N}{\beta_2^{N2} \Sigma_1^N + \sigma_u^2} \tag{18}$$

(10) and (17) imply

$$\beta_2^D = \frac{\sigma_u}{\sqrt{\Sigma_1^D}} \tag{19}$$

$$\lambda_2^D = \frac{\sqrt{\Sigma_1^D}}{2\sigma_u} \tag{20}$$

while (11) and (18) imply

$$\beta_2^N = \frac{\sigma_u}{\sqrt{\Sigma_1^N}} \tag{21}$$

$$\lambda_2^N = \frac{\sqrt{\Sigma_1^N}}{2\sigma_u} \tag{22}$$

Substituting (14), (15) and (20) into (12) gives us

$$\beta_1 = \frac{\sigma_u \sigma_\eta}{(1-\alpha)\,\Sigma_0}\sqrt{\frac{\Sigma_0 + \sigma_\eta^2}{\Sigma_0}} \tag{23}$$

$$\lambda_1 = \frac{(1-\alpha)\,\Sigma_0 \sigma_\eta}{\sigma_u \left(\sigma_\eta^2 + (1-\alpha)^2\,\Sigma_0\right)}\sqrt{\frac{\Sigma_0}{\Sigma_0 + \sigma_\eta^2}} \tag{24}$$

Substituting (16), (22), (23) and (24) into (13) results in the following equation for σ_η^2

$$\left((1-\alpha)^2 - h\right)\sqrt{h + (1-\alpha)^2} - \alpha\,(1-\alpha)^2\sqrt{h} = 0 \tag{25}$$

where $\sigma_\eta^2 = h\Sigma_0$

Expected profits in first period

$$E\,(\pi_1) = E\,[(v - P_1)\,x_1|v]$$
$$= E\,[(v - P_0 - \lambda_1\beta_1\,(v' - P_0))\,\beta_1\,(v' - P_0)]$$
$$= \tfrac{\beta_1(1-\lambda_1\beta_1)\Sigma_0}{1+h}$$

Expected profits in second period with successful application

$$E\left(\pi_2^N\right) = E\left[\left(v - P_2^N\right)x_2^N|v\right]$$
$$= E\left[\left(v - v' + \tfrac{1}{2}\,(v' - P_1)\right)\beta_2^N\,(v' - P_1)\right]$$
$$= \tfrac{\beta_2^N\Sigma_1^N}{2}$$

Expected profits in second period with unsuccessful application

$$E\left(\pi_2^D\right) = E\left[\left(v - P_2^D\right) x_2^D | v\right]$$
$$= E\left[\frac{1}{2}\beta_2^D\left(v - v'\right)^2\right]$$
$$= \frac{\beta_2^D \Sigma_1^D}{2}$$

■

Proof of Proposition 2. If the manager's second period trade is not enforced by the SEC in the event he is granted confidential treatment, he is free to use v instead of $\widehat{v}'$. Therefore we have

$$\widehat{x}_2^N = \widehat{\beta}_2^N\left(v - \widehat{P}_1\right) \tag{26}$$

$$E\left[\widehat{\pi}_2^N\left(\widehat{P}_1, v\right)|v\right] = E\left[\left(v - \widehat{P}_2^N\right)\widehat{x}_2^N|v\right] = \frac{1}{4\widehat{\lambda}_2^N}\left(v - \widehat{P}_1\right)^2$$

Similar to the proof in Proposition 1, we obtain

$$\widehat{\beta}_2^N = \frac{1}{2\widehat{\lambda}_2^N} \tag{27}$$

$$\widehat{x}_2^D = \widehat{\beta}_2^D\left(v - \widehat{v}'\right) \tag{28}$$

$$\widehat{\beta}_2^D = \frac{1}{2\widehat{\lambda}_2^D} \tag{29}$$

Stepping back to the first period, the total expected profits in both periods is

$$E\left[\left(v - \widehat{P}_1\right)\widehat{x}_1 + (1-\alpha)\,\widehat{\pi}_2^D\left(\widehat{v}', v\right) + \alpha\widehat{\pi}_2^N\left(\widehat{P}_1, v\right)|v\right]$$
$$= E\left[\left(v - P_0 - \widehat{\lambda}_1\widehat{x}_1\right)\widehat{x}_1 + \frac{1-\alpha}{4\widehat{\lambda}_2^D}\left(v - P_0 - \frac{\widehat{x}_1}{\widehat{\beta}_1}\right)^2 + \frac{\alpha}{4\widehat{\lambda}_2^N}\left(v - P_0 - \widehat{\lambda}_1\widehat{x}_1\right)^2\right]$$

Taking first order condition with respect to x_1

$$(v - P_0)\left(1 - \frac{1-\alpha}{2\widehat{\lambda}_2^D \widehat{\beta}_1} - \frac{\alpha \widehat{\lambda}_1}{2\widehat{\lambda}_2^N}\right) + \widehat{x}_1 \left(-2\widehat{\lambda}_1 + \frac{1-\alpha}{2\widehat{\lambda}_2^D \widehat{\beta}_1^2} + \frac{\alpha \widehat{\lambda}_1^2}{2\widehat{\lambda}_2^N}\right) = 0$$

The second-order condition is

$$-2\widehat{\lambda}_1 + \frac{1-\alpha}{2\widehat{\lambda}_2^D \widehat{\beta}_1^2} + \frac{\alpha \widehat{\lambda}_1^2}{2\widehat{\lambda}_2^N} \leq 0$$

For the mixed strategy $\theta = v + \eta$, $\eta \sim N\left(0, \widehat{\sigma}_\eta^2\right)$ to hold in equilibrium, the manager must be different across all values of $\widehat{x}_1$, as $\widehat{x}_1$ is a function of θ. We seek positive values of $\widehat{\lambda}_1$, $\widehat{\lambda}_2^D$ and $\widehat{\lambda}_2^N$ such that

$$1 - \frac{1-\alpha}{2\widehat{\lambda}_2^D \widehat{\beta}_1} - \frac{\alpha \widehat{\lambda}_1}{2\widehat{\lambda}_2^N} = 0$$

and

$$-2\widehat{\lambda}_1 + \frac{1-\alpha}{2\widehat{\lambda}_2^D \widehat{\beta}_1^2} + \frac{\alpha \widehat{\lambda}_1^2}{2\widehat{\lambda}_2^N} = 0$$

Re-arranging terms

$$\widehat{\beta}_1 = \frac{2\widehat{\lambda}_2^N - \alpha \widehat{\lambda}_1}{\widehat{\lambda}_1 \left(4\widehat{\lambda}_2^N - \alpha \widehat{\lambda}_1\right)} \tag{30}$$

$$\widehat{\lambda}_1 = \frac{1-\alpha}{\widehat{\beta}_1 \left(2\widehat{\lambda}_2^D \widehat{\beta}_1 + 1 - \alpha\right)} \tag{31}$$

Using the projection theorem of normal random variables on $\widehat{y}_1$, $\widehat{y}_2^N$ and $\widehat{y}_2^D$, we obtain

$$\widehat{\lambda}_1 = \frac{\frac{\widehat{\beta}_1 \Sigma_0^2}{\Sigma_0 + \widehat{\sigma}_\eta^2}}{\frac{\widehat{\beta}_1^2 \Sigma_0^2}{\Sigma_0 + \widehat{\sigma}_\eta^2} + \sigma_u^2} \tag{32}$$

$$\widehat{\Sigma}_1^D = \frac{\widehat{\sigma}_\eta^2}{\Sigma_0 + \widehat{\sigma}_\eta^2} \Sigma_0 \tag{33}$$

$$\widehat{\Sigma}_1^N = \Sigma_0 - \frac{\left(\frac{\widehat{\beta}_1 \Sigma_0^2}{\Sigma_0 + \widehat{\sigma}_\eta^2}\right)^2}{\frac{\widehat{\beta}_1^2 \Sigma_0^2}{\Sigma_0 + \widehat{\sigma}_\eta^2} + \widehat{\sigma}_u^2} \tag{34}$$

$$\widehat{\lambda}_2^D = \frac{\widehat{\beta}_2^D \widehat{\Sigma}_1^D}{\widehat{\beta}_2^{D2} \widehat{\Sigma}_1^D + \sigma_u^2} \tag{35}$$

$$\widehat{\lambda}_2^N = \frac{\widehat{\beta}_2^N \widehat{\Sigma}_1^N}{\widehat{\beta}_2^{N2} \widehat{\Sigma}_1^N + \sigma_u^2} \tag{36}$$

(29) and (35) imply

$$\widehat{\beta}_2^D = \frac{\sigma_u}{\sqrt{\widehat{\Sigma}_1^D}} \tag{37}$$

$$\widehat{\lambda}_2^D = \frac{\sqrt{\widehat{\Sigma}_1^D}}{2\sigma_u} \tag{38}$$

while (27) and (36) imply

$$\widehat{\beta}_2^N = \frac{\sigma_u}{\sqrt{\widehat{\Sigma}_1^N}} \tag{39}$$

$$\widehat{\lambda}_2^N = \frac{\sqrt{\widehat{\Sigma}_1^N}}{2\sigma_u} \tag{40}$$

Substituting (32), (33) and (38) into (31) gives us

$$\widehat{\beta}_1 = \sigma_u \left(\frac{1-\alpha}{\Sigma_0 \widehat{\sigma}_\eta}\right)^{1/3} \sqrt{\frac{\Sigma_0 + \widehat{\sigma}_\eta^2}{\Sigma_0}} \tag{41}$$

$$\widehat{\lambda}_1 = \frac{1-\alpha}{\sigma_u \left(\frac{1-\alpha}{\Sigma_0 \widehat{\sigma}_\eta}\right)^{1/3} \left(\widehat{\sigma}_\eta \left(\frac{1-\alpha}{\Sigma_0 \widehat{\sigma}_\eta}\right)^{1/3} + 1 - \alpha\right)} \sqrt{\frac{\Sigma_0}{\Sigma_0 + \widehat{\sigma}_\eta^2}} \tag{42}$$

Substituting (34), (40), (41) and (42) into (30) results in the following equation for $\widehat{\sigma}_\eta^2$

$$\alpha \sqrt{\frac{g}{g+1}} - (1-\alpha)\left(g^{2/3}(1-\alpha)^{-4/3} - 1\right) \sqrt{\frac{\frac{g^{2/3}}{1+g}(1-\alpha)^{2/3} + 1}{g^{-1/3}(1-\alpha)^{2/3} + 1}} = 0 \tag{43}$$

where $\widehat{\sigma}_\eta^2 = g\Sigma_0$

Expected profits in first period

$$\begin{aligned}
E\left(\widehat{\pi}_1\right) &= E\left[\left(v-\widehat{P}_1\right)\widehat{x}_1|v\right]\\
&= E\left[\left(v-P_0-\widehat{\lambda}_1\widehat{\beta}_1\left(\widehat{v}'-P_0\right)\right)\widehat{\beta}_1\left(\widehat{v}'-P_0\right)\right]\\
&= \frac{\widehat{\beta}_1\left(1-\widehat{\lambda}_1\widehat{\beta}_1\right)\Sigma_0}{1+g}
\end{aligned}$$

Expected profits in second period with successful application

$$\begin{aligned}
E\left(\widehat{\pi}_2^N\right) &= E\left[\left(v-\widehat{P}_2^N\right)\widehat{x}_2^N|v\right]\\
&= E\left[\tfrac{1}{2}\widehat{\beta}_2^N\left(v-\widehat{P}_1\right)^2\right]\\
&= \frac{\widehat{\beta}_2^N\widehat{\Sigma}_1^N}{2}
\end{aligned}$$

Expected profits in second period with unsuccessful application

$$\begin{aligned}
E\left(\widehat{\pi}_2^D\right) &= E\left[\left(v-\widehat{P}_2^D\right)\widehat{x}_2^D|v\right]\\
&= E\left[\tfrac{1}{2}\widehat{\beta}_2^D\left(v-\widehat{v}'\right)^2\right]\\
&= \frac{\widehat{\beta}_2^D\widehat{\Sigma}_1^D}{2}
\end{aligned}$$

■

Proof of Proposition 3. If the SEC constraints the manager's second period trade, the manager's total profits is lower than those obtained from a trading strategy of disclosure as in Huddart et al. (2001) if

$$E\left(\pi_1\right)+\alpha E\left(\pi_2^N\right)+\left(1-\alpha\right)E\left(\pi_2^D\right)\leq\sigma_u\sqrt{\frac{\Sigma_0}{2}} \tag{44}$$

From the plot of the expected profit function in Figure 2, there is a threshold value of α which we will call α^*, below which total expected profits from application are lower than with disclosure. α^* satisfies the equality

$$E\left(\pi_1\right)+\alpha E\left(\pi_2^N\right)+(1-\alpha)\,E\left(\pi_2^D\right)=\sigma_u\sqrt{\frac{\Sigma_0}{2}} \tag{45}$$

Substituting the profit functions in Proposition 1 into (45)

$$\frac{1-\alpha}{\sqrt{1+h}}\left[\frac{2\sqrt{h}}{h+(1-\alpha)^2}+\frac{\alpha}{\sqrt{h+(1-\alpha)^2}}+\sqrt{h}\right]-\sqrt{2}=0 \tag{46}$$

Notice that the exogenous parameters σ_u and Σ_0 are not present in (46). From (46) and (25), we obtain numerically to 3 decimal places:

$$\alpha^* \approx 0.361$$

On the other hand, if the SEC does not restrict his second period trade, we find that

$$E\left(\widehat{\pi}_1\right)+\alpha E\left(\widehat{\pi}_2^N\right)+(1-\alpha)\,E\left(\widehat{\pi}_2^D\right)\geq\sigma_u\sqrt{\frac{\Sigma_0}{2}} \tag{47}$$

This means the manager's expected profits will always be higher than in the Huddart et al. (2001) case. ■