

An Economic Model of Insider Trading with an Informed Third Party

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Abstract: The fact that an insider gains only at the expense of an outsider, manipulative insider trading precipitates a conflict of interests. We model this conflict in an extended principal-agent framework to demonstrate that the endogenous demand for reliable information would limit the volume and persistence of manipulative insider trading. An important dimension of such an insider trading is that an insider may not always have the manipulative power and hence may rely on an informed third party for an effective manipulation. Earlier studies did not consider this possibility. We demonstrate in this new framework that the level of manipulative insider trading depends on the combination of the self-correcting market forces and the legal institutions.

Key words: Insider trading, silent trading, manipulative insider trading, credibility, honest trading

INTRODUCTION

In recent years there has been increasing interest in insider trading and three major debates have emerged from these works. First and foremost, some of these works posed the question whether insider trading is short-lived. Manne^[1] championed that insider trading is short-lived by arguing that manipulators would easily be exposed and hence they would lose all credibility^[1]. Benabou and Laroque^[2] have provided a new, streamlined exposition of the question if private information is not fully credible. In such a scenario^[2] demonstrated that an insider may repeatedly deceive the public by strategically distorting information. Such a possibility arises since an informed agent can make honest mistakes and a manipulator may hide behind the honest traders. This turns out to be feasible since public takes some time to learn whether the error committed by the manipulator is deliberate, or honest miscalculation. This notion derives from the interaction between ambiguity and learning which creates a leeway for the manipulator for at least a finite horizon^[3].

In a seminal paper Benabou and Laroque^[2] drew a distinction between “manipulative” insider trading and “silent” insider trading. In “silent” trading an insider merely has an informational advantage which prompts his trading behaviour. On the contrary, a manipulative trader gains not only from his informational advantage but also from his biased messages (Such biased messages are likely to affect the public opinion since the manipulators have high credibility and good reputation. This implies that the manipulators do not have to be an insider. A manipulator is basically a credible agent whose reputation derives from his good research and informed prediction). Such a distinction pushes the second and third debates to the periphery for issues involving manipulative trading. Since market

manipulation is “unfair”, there is near unanimity that such a trading must be prohibited. Such activities are mostly clandestine and, hence, there is very little scope to make relevant transfer payments. Therefore, the central concern of manipulative insider trading turns out to be twofold: first, what determines the volume/size of insider trading? Secondly, is insider trading short-lived? The study attempts to provide plausible answers to the twin questions. The contribution of this study is threefold: first, we extend the analysis of^[2] by separating the insider from the manipulator. A key element in^[2] is the “credibility” of the insider which influences the public opinion. The implicit assumption is that the insider enjoys such “credibility”. We modify this by postulating that the insider does not have the manipulative power and, therefore, rely on a third party for an effective manipulation. The volume and persistence of insider trading would, therefore, latch on the “credibility” of the manipulator. It is quite evident that the “credibility” would bear an inverse relation to manipulation and a direct relation to the supply of honest and reliable information. As a result, the decision to manipulate would mesh in with the market for honest and reliable information. We develop a simple model to explore the interrelationships between the manipulation and the market for honest and reliable information.

The immediate fallout of the extension is that the manipulator confronts two distinct types of customers. First, the uninformed agents who have a demand for honest and reliable information. Second, the informed agents who have a demand for strategically biased information. Evidently, there emerges a conflict of interests between insiders and outsiders in such markets. Robbins^[4] pointed out the importance of such market conflict and provided an intuitive argument that the endogenous market adjustment would successfully

eradicate such a conflict^[4]. The main contribution of this study is to examine this possibility in the light of the extended model in^[2] by highlighting the interaction between honest and reliable information vis-a-vis strategically biased information. The plan of the study is as follows. Section 2 provides the model. We show how the interplay of reliable and strategic information would steadfastly dispel strategic manipulation. Section 3 makes concluding comments.

THE MODEL

Manipulation of information: There are three types of agents, namely A, P and O. We label the manipulator as A who has the “credibility” to influence public opinion and his collaborator is P who has the inside information. The uninformed agent is labelled as O who is an outsider. We postulate that there are two manipulators A₁ and A₂. They sell honest and reliable information to uninformed agents O. There is an a priori matching of A and P which is the basis of the manipulation of information. We do not explain how such collaboration takes place. Ignoring the subscript we explain the relationship between A and P.

P has a Neumann-Morgenstern utility index U (R-T) when R is the pecuniary return to P from manipulated information, and T is the payment (either explicit or implicit) made to A. Likewise A has a utility function V (T,a) such that

$$V_T \geq 0, V_{TT} \leq 0, V_a \leq 0 \text{ and } V_{aa} > 0.$$

When “a” is the “action” that manipulates information.

Observation 1: There is a potential conflict of interest between A and P as the action “a” is costly for A, while it does not directly enter the payoff of P. If A acts in his best interest, then his optimal level of manipulation would diverge from P's utility maximising level.

We assume that there is an intrinsic uncertainty in the activity so that R is a random variable (Suppose a bank is going to make a loss. The informed agent may make a prediction but the uninformed agent may not act being a long run optimiser. This may engender an uncertainty concerning R). Hence we write

$$R = R(a, \epsilon) \tag{1a}$$

When ϵ is a random variable. We further assume that P can observe “a”, then he chooses “T” and “a” in such a way as to maximise his expected utility subject to the constraint that A receives his “reservation utility”. Such a formulation avoids the complexity of conflict between A and P.

Observation 2: Since “a” and ϵ are costlessly observed, P selects a payment schedule T* (ϵ) which maximises P's utility after providing for A's “reservation utility”. Hence

the optimal payment is given by the following:

$$T^*(\epsilon) = \text{argmax} \int U(R(a, \epsilon) - T(\epsilon))f(\epsilon)d\epsilon \tag{1b}$$

subject to

$$\int V(a, T(\epsilon))f(\epsilon)d\epsilon \geq V^0 \tag{1c}$$

$$\frac{dM(a)}{da} = \frac{dV^0}{da} \tag{1d}$$

Where, function f(ϵ) is the probability distribution of the random variable ϵ .

Observation 3: The utility maximising choice of “a” when P is risk neutral calls forth the following:
Where

$$M(a) = \int R(a, \epsilon) f(\epsilon) d\epsilon$$

Where, M (a) is the expected total pecuniary returns from manipulation of information “a”^[5] for the elaboration of this point).

The interpretation is quite straightforward. To induce A to choose a particular level of “a”, P will offer him a fixed payment which must lie on the schedule V⁰ and, hence, A would receive his reservation utility. Hence V⁰ appears as a typical cost function which constrains the decision of P. P chooses a = a* such that the marginal benefit from information manipulation is equal to the cost at the margin.

The factors affecting an optimal level of “a” subsume two categories. First are the deterrence variables as created by the legal and institutional set-up. Secondly the marginal return from information manipulation is important. We ignore the deterrence variable and instead concentrate mainly on the marginal return, for the time being. It is obvious that the marginal return hinges on the reservation utility of A and therefore one must explain the reservation utility for examining the optimal “a”. The reservation utility remains a relatively unexplained phenomenon in the principal-agent theory while it is usually believed to be “market determined”. The work^[6], while launching the principal-agent model, stressed the need for a theory of market interactions to explain the reservation utility. Yet the explanation remains inadequate as explained in^[5]. In the following section we deal with the determination of the reservation utility which in turn sheds light on the optimal value of “a”.

THE MARKET FOR HONEST AND RELIABLE INFORMATION

In the above analysis an optimal volume of manipulation of information is produced through the interaction between A and P. But this interaction remains

incomplete since it does not incorporate the cost that the outsiders bear in the market. Hence an important element turns out to be the responses of the outsiders to the information manipulation. The response of an outsider determines the opportunity cost of manipulation of information. This opportunity cost represents the reservation utility of agent A.

We supposed there are two manipulators or sellers of information in the market while the (market) demand for honest information is given by the following inverse demand function:

$$p = A - bX \tag{2}$$

Where, $X = X_1 + X_2$, X is an index of the quantity of honest information and the subscript implies the source of the information. We posit that the act of manipulation adds instability in the demand for reliable information. This is because if the quality of information gets adversely affected by the manipulation, then different buyers (outsiders) would have different responses. As a result we write the inverse demand function as:

$$p = A - bX + e \tag{3}$$

When e is a white noise with mean e^* , variance δ . If e is high, demand for reliable information is high and vice-versa. Assuming manipulators to be risk averse in the market for good information, each seller now maximises his net utility Q_i :

$$Q_i(X) = E(\Pi_i) - \beta_i V(\Pi_i) \tag{4}$$

When Π_i is the profit of the i th seller, $E(\Pi_i)$ is the expected profit, β_i is the risk aversion coefficient, $V(\Pi_i)$ is the variance in profit due to instability in demand. Based on these intuitions the results would follow.

Proposition 1: Under demand uncertainty, as caused by manipulation of information, profit maximisation calls for the equality of marginal revenue with marginal cost plus a risk premium.

Proof: See the appendix.

Proposition 2: The Nash-Cournot strategies of the sellers are the following:

$$X_1 = \frac{B - X_2}{2(1 + \beta_1\delta)} \tag{5a}$$

$$X_2 = \frac{B - X_1}{2(1 + \beta_2\delta)} \tag{5b}$$

Where, $B = A - C - \delta$, C is the marginal cost of producing reliable information and δ is the variance of

the demand fluctuation.

Proof: See the appendix.

Proposition 3: The Nash-Cournot equilibrium outputs of reliable information are given by the following:

$$X_1^* = B \frac{2(1 + \beta_2\delta) - 1}{4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1} \tag{6a}$$

$$X_2^* = B \frac{2(1 + \beta_1\delta) - 1}{4(1 + \beta_2\delta)(1 + \beta_1\delta) - 1} \tag{6b}$$

Proof: See the appendix.

Lemma 1: If m_1 is the proportionate change in the profit of seller 1 then,

$$m_1 = \left(\frac{X_1}{X_1 + X_2} + 1\right) \dot{X}_1 + \left(\frac{X_2}{X_1 + X_2}\right) \dot{X}_2 \tag{7a}$$

Where, X_1 and X_2 denote the proportionate changes in outputs.

Proof: Since $\Pi_1 = pX_1$, assuming the marginal cost of producing reliable information to be zero, then one can easily derive

$$m_1 = \dot{p} + \dot{X}_1 \tag{7b}$$

Since

$$p(t) = A - bX_1(t) - bX_2(t) \tag{8a}$$

$$p(t+1) = A - bX_1(t+1) - bX_2(t+1) \tag{8b}$$

Hence

$$p(t+1) - p(t) = -b[X_1(t+1) + X_2(t+1)] + b[X_1(t) + X_2(t)] \tag{8c}$$

Normalising the price change by setting $A=0$, we get the following:

$$\begin{aligned} \dot{p} &= \frac{p(t+1) - p(t)}{p(t)} \\ &= \frac{X_1(t+1) + X_2(t+1)}{X_1(t) + X_2(t)} - 1 \\ &= \frac{X_1}{X_1 + X_2} \dot{X}_1 + \frac{X_2}{X_1 + X_2} \dot{X}_2 \end{aligned} \tag{9a}$$

Lemma 2: If information manipulation results in a spread-preserving decline in the mean demand e^* , then both sellers reduce outputs.

Proof: From equations (5a) and (5b) the Nash-Cournot strategies reduce to the following:

$$2(1 + \beta_1\delta)X_1 + X_2 = A + e^* \tag{10a}$$

$$X_1 + 2(1 + \beta_2\delta)X_2 = A + e^* \quad (10b)$$

From the above equation system one can easily derive the following if the stability condition is fulfilled,

$$\frac{dX_1}{de^*} = \frac{1 + 2\beta_1\delta}{4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1} > 0 \quad (11a)$$

$$\frac{dX_2}{de^*} = \frac{1 + \beta_1\delta}{4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1} > 0 \quad (11b)$$

Therefore, as e^* declines outputs X_1 and X_2 both decline.

Lemma 3: If manipulation of information results in a mean preserving increase in the variability of demand for reliable and honest information (δ), then each seller reduces his supply of reliable and honest information if the risk aversion coefficients of the sellers are similar.

Proof: Again from the Nash-Cournot responses of the sellers' one can easily derive the following:

$$\frac{dX_1}{d\delta} = \frac{2\beta_1 - 4\beta_2(1 + \beta_2\delta)}{4(1 + \beta_2\delta)(1 + \beta_2\delta) - 1} < 0 \quad (12a)$$

The above inequality holds for seller 1 if values of β_1 and β_2 are close. Similarly one can easily verify that X_2 and δ vary in opposite direction.

Theorem 1: If manipulation of information lowers e^* and increases δ ; then as a seller increases the supply of manipulated information ("a"), his profit declines from the sales of reliable and honest information. As a result, the opportunity cost of manipulation goes up with an increase in "a" which establishes an upward sloped "reservation utility" function V^0 .

Proof: Lemma 2 and 3 establish the following:

$$\dot{X}_1 < 0, \dot{X}_2 < 0.$$

From Lemma 1 we know that

$$m_1 = \left(1 + \frac{X_1}{X_1 + X_2}\right)\dot{X}_1 + \frac{X_2}{X_1 + X_2}\dot{X}_2 \quad (13)$$

Since X_1 and X_2 are negative therefore m_1 is negative. Hence as seller one increases "a", his profit from the sales of reliable and honest information declines. Similarly we can show that for the second seller's profit from reliable and honest information declines as he increases manipulation of information. This establishes that the reservation utility of each seller is an increasing function of "a".

Theorem 2: If a seller's risk aversion increases with an actual manipulation, then $Q_i(X)$ declines for each level of manipulation "a".

Proof: Let us consider the first seller. From Proposition 3 we know that as β_1 increases his Nash-Cournot (equilibrium) strategy X_1^* changes by the following:

$$\begin{aligned} \frac{dX_1^*}{d\beta_1} &= \frac{-4\delta(1 + \beta_2\delta)A[a(1 + \beta_2\delta) - 1]}{[4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1]^2} \\ &= -\frac{4\delta(1 + \delta\beta_2)}{4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1} X_1^* < 0 \end{aligned} \quad (14)$$

As X_1^* declines, the Nash-Cournot response of second seller increases X_2 . Differentiating X_2^* with respect to β_1 we get the following:

$$\begin{aligned} \frac{dX_2^*}{d\beta_1} &= \frac{2A\delta + 4A\beta_2\delta^2}{[4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1]^2} \\ &= \frac{2\delta X_2}{4(1 + \beta_1\delta)(1 + \beta_2\delta)} > 0. \end{aligned} \quad (15)$$

Furthermore we know that

$$\begin{aligned} \frac{d(X_1^* + X_2^*)}{d\beta_1} &= -\frac{(2\delta X_2 + 4X_1 - 4\beta_1 + 4\delta^2\beta_1 X_1)}{4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1} < 0 \end{aligned} \quad (16)$$

As a result as β_1 increases X_1^* declines whereas X_2^* increases but the decline in X_1 is greater than the increase in X_2 . As a result from lemma 1 we know that $m_1 < 0$. Hence given "a", as β_1 increases Π_1 diminishes. Hence from the utility function one knows that, since $E(\Pi_1)$ declines and $\beta_1 V(\Pi_1)$ goes up, utility of first seller, Q_1 , declines for each level of manipulation "a". This is the opportunity cost of manipulation which goes up as the seller undertakes an optimal manipulation a^* , since a^* increases his risk aversion. As a consequence, as the seller undertakes an optimal manipulation a^* , his reservation utility function V^0 shifts up which reduces the profitability from manipulation for all levels in the subsequent periods.

Theorem 3: As the seller undertakes an optimal manipulation a^* , the slope of the reservation utility function V^0 becomes steeper for all "a" which progressively reduces the optimal value of "a".

Proof: The first seller's opportunity cost is given by the decline in Q_1 , then the slope of V^0 for any "a" is given by the following:

$$\frac{dV^0}{da} = -\frac{dQ_1}{da} = -E\left(\frac{d\Pi_1}{da}\right) + \beta_1 \frac{dV(\Pi_1)}{da} \quad (17)$$

Since the profit is adversely affected by “a” and variability of profit goes up with “a”, V^0 is positively sloped. As β_1 goes up, the slope is also affected in the following manner:

$$\frac{d\left(\frac{-dQ_1}{da}\right)}{d\beta_1} = \frac{dV(\Pi_1)}{da} > 0 \quad (18)$$

As a typical seller manipulates information, it increases the total cost as well as the marginal cost of market manipulation and hence the optimal value of “a” declines. This causes the reservation utility function to shift upward. The reservation utility function is the cost function of the principal “P”. Thus not only the net returns from manipulation decline for the principal “P”, but also the optimal level of distortion a^* steadily declines as described in the following diagram. There is, hence, a reason to believe that market forces lead to a gradual shrinkage of manipulative insider trading.

CONCLUSION

In this study we showed that manipulative insider trading would precipitate a specific conflict of interests which previous works ignored. Conflict arises as an insider gains at the cost of an outsider while a manipulative trading is carried out by an agent with significant “credibility”. Eastbrook^[7] reduced the insider trading problem as a principal-agent problem and also highlighted an outsider as a source of profit for an insider trading. But he did not consider the fact that there may be a middle man, or third party, through whom an insider operates. The importance of the third party emerges from his manipulative power which an insider may lack. The successful operation of insider trading may, therefore, hinge on the third party's willingness to undertake such an operation. The willingness of the third party depends upon his expected gains from manipulation and the loss he incurs from a decline in the demand for reliable and honest information of the outsider and the penalty that he may receive due to legal restrictions. We postulate that the net return of the third party depends on the expected profit and his degree of risk aversion. We argue that actual manipulation impinges on his returns from reliable information which turns out to be an opportunity cost of manipulation. The third party, hence, confronts a cost from the conflict of interests between insiders and outsiders. This suggests that the opportunity cost of manipulation as borne by the third party may play a crucial role in limiting the manipulative activities. The main intuition is that insider trading may result in a conflict of interests amongst market participants. Robbins^[4] analysed such a market conflict and argued that free market forces would resolve this conflict. Manne^[1] examined the possibility of conflict resolution in the context of insider trading and drew the conclusion

that market forces would successfully limit insider trading. Benabou^[2] also demonstrated the short life-span of manipulative traders. We have rigorously examined this issue in the context of information manipulation and demonstrated that the life-span of such manipulative insider trading depends on a complex interplay of market forces and legal system. Therefore, quite contrary to the expectations of Robbins and Manne, this study constructively argues that self-correcting market forces may fail to eliminate such a conflict. As a consequence, manipulative insider trading may not be short-lived.

Appendix

Proof of proposition 1: Since the maximand of the first seller

$$M_1 = E(\Pi_1) - \beta_1 V(\Pi_1) \quad (a1)$$

utility maximisation calls forth the following

$$\frac{dM_1}{dX_1} = \frac{dE(\Pi_1)}{dX_1} - \beta_1 \frac{dV(\Pi_1)}{dX_1} = 0 \quad (a2)$$

Which can easily be reduced to the following

$$E(MR) - C - r = 0 \quad (a3)$$

When $E(MR)$ is the expected value of marginal revenue, C is the marginal cost and r is the risk premium. Q.E.D

Proof of proposition 2: Assuming the variance in profit given by the demand instability one may write the variance $V(\Pi_1)$ as

$$V(\Pi_1) = \delta X_1^2 \quad (a4)$$

As a result $M1$ reduces to the following since the postulated linear demand function:

$$M_1 = X_1 (A - b X_1 - b X_2 - C + e^*) - \delta \beta_1 X_1^2 \quad (a5)$$

While e^* is the mean of demand fluctuation.

Differentiating M_1 with respect to X_1 and setting the marginal value equal to zero yields the following:

$$2(1 + \beta_1 \delta) X_1 + X_2 = A + e^* - C \quad (a6)$$

Which is the Nash-Cournot strategy of the first seller. Following similar steps one can easily derive second seller' optimal response. Q.E.D.

Proof of proposition 3: The Nash-Cournot strategies provide us the following linear equations:

$$2(1 + \delta \beta_1) X_1 + X_2 = B \quad (a7)$$

$$X_1 + 2(1+\delta\beta_2)X_2 = B \quad (a8)$$

Where $B = A + e^* - C$.

Solving the linear system simultaneously one gets the following:

$$X_1^* = \frac{2B(1 + \beta_2\delta) - B}{4(1 + \beta_1\delta)(\beta_2\delta) - 1} \quad (a9)$$

$$X_2^* = \frac{2(1 + \beta_1\delta) - B}{4(1 + \beta_1\delta)(1 + \beta_2\delta) - 1} \quad (a10)$$

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