NOISE TRADING, DELEGATED PORTFOLIO MANAGEMENT, AND ECONOMIC WELFARE

by

James Dow
Gary Gorton

19-94

RODNEY L. WHITE CENTER FOR FINANCIAL RESEARCH
The Wharton School
University of Pennsylvania
Philadelphia, PA 19104-6367

Noise Trading, Delegated Portfolio Management, and Economic Welfare*

James Dow
London Business School

Gary Gorton
The Wharton School
University of Pennsylvania
and NBER

June 1994

Abstract

We consider a model of the stock market with delegated portfolio management. All agents are rational: some trade for hedging reasons, some investors optimally contract with portfolio managers who may have stock-picking abilities, and portfolio managers trade optimally given the incentives provided by this contract. Managers try, but sometimes fail, to discover profitable trading opportunities. Although it is best not to trade in this case, their clients cannot distinguish "actively doing nothing," in this sense, from "simply doing nothing." Because of this problem: (i) some portfolio managers trade even though they have no reason to prefer one asset to another (noise trade). We also show that, (ii), the amount of such noise trade can be large compared to the amount of hedging volume. Perhaps surprisingly, (iii), noise trade may be Pareto-improving. Noise trade may be viewed as a public good. Results (i) and (ii) are compatible with observed high levels of turnover in securities markets. Result (iii) illustrates some of the possible subtleties of the welfare economics of financial markets.

* We thank Andrew Atkeson, François Longin, Sam Orez, and Patrick Rey for comments. Thanks also to Harold Mulherin for sharing some of his data and to Lori Gorton and Terry Hildenbrand for research assistance. Gorton thanks the Bank of England for support during his tenure as a Houblon-Norman Fellow.

On the New York Stock Exchange, turnover in 1992 was 48%. While there is no convincing theoretical prediction for assessing these numbers, many observers have the view that turnover is very high. For example, the Presidential Task Force on Market Mechanisms (1988) presents this viewpoint. As in the foreign exchange market, on the NYSE the increase in turnover has been accompanied by a rise in institutional ownership. This casual observation of a positive correlation between turnover and institutional ownership is confirmed when we take account of the decline in real trading costs over the post-WWII period. A regression of turnover on institutional ownership and real commissions per share shows that institutional ownership is still highly significant in explaining turnover.[3] As with foreign exchange, the available evidence is at least suggestive of a causal link between turnover and institutional control.

It seems difficult to explain the level of trading activity purely on the basis of "rational" motives for trade. Hedging and liquidity seem likely to explain only a small fraction of this trade, and it seems unreasonable to suppose that a small amount of such uninformed trade can support a large amount of informed trade. Hence the appeal of the "irrational" point of view. In contrast, we consider another motive for rational, uninformed agents to trade. We argue that it is capable of explaining a significant amount of trade. It is also consistent with the observed correlation between volume and institutional presence.

The motive stems from a contracting problem between professional traders and their clients or employers. We have in mind two settings in which the problem may arise. In one setting, an investor hires a fund management firm. The other setting is one in which a firm hires an employee to trade securities on its behalf. In both settings, there is likely to be a difficulty in writing incentive compatible, efficient compensation contracts. In this context money managers may engage in ex ante unprofitable trades which have some chance of being profitable ex post. One goal of this paper is to investigate this possibility and to analyze the conditions under which such trade can be sizeable.

In our setting portfolio managers who engage in producing information do not always uncover profitable trading opportunities. It can happen that inactivity (i.e. not trading) is the (first-best) optimal decision because the portfolio manager's effort at finding mispriced securities did not uncover any. The contracting problem that arises in our model is whether the delegated portfolio manager can convince the client/employer that inactivity was his best strategy.[4] The difficulty is that the employer cannot distinguish "actively doing nothing" in this sense from "simply doing nothing." If the contract allows a reward for not trading, portfolio managers may simply do nothing; the contract may either attract incompetent managers or lead competent managers to shirk. If this makes it impossible to reward inactivity, and limited liability prevents punishing ex post incorrect decisions, then the optimal contract may induce trading by the portfolio manager which is simply a gamble to produce a satisfactory outcome by chance. We call this noise trade or churning.[5] In the first part of the paper we show that noise trade will occur in equilibrium.

The contracting environment we study is a simple one in which the portfolio manager is unable to convince his employer that any inactivity is optimal. In our setting inactivity is not rewarded because that would induce shirking by talented portfolio managers and it would attract incompetent portfolio managers. In many simple contracting environments this problem could be solved by a two-part contract that specifies: (i) a large bonus for taking correct trading positions; and (ii), a smaller, lump-sum, payment for inactivity. Talented portfolio managers would be attracted by the chance of the bonus, but ex post, if they happened not to uncover trading opportunities, the lump-sum would be chosen in preference to trading randomly as a gamble to earn the bonus. Incompetent portfolio managers would not sign the contract if the lump-sum is not as large as their opportunity cost. Our environment is chosen with care so that this contract, and others like it, cannot eliminate the agency problem. Of course, if the contracting problem does arise in reality, as we suggest, it is presumably in the context of a more complex, repeated, environment that would not be as analytically tractable as the one specified here.

In the latter part of the paper, we consider the implications of noise trading for agents' welfare. Noise trading would appear to be costly for the employer since it lowers the expected rate of return on the portfolio. On the other hand, it will benefit hedgers: if managed portfolios earn lower rates of return, then uninformed hedgers earn higher returns. However, there is another effect. The higher return earned by the hedgers effectively reduces the cost principal), is "shirking." Agents might want to do this if the contract specifies a payment for doing nothing, i.e. a payment in the event of no trade.

If a talented agent actively works for the principal, he may or may not receive private information. If he receives private information, he can manage the portfolio to generate superior returns. Even if he does not receive private information, he can still choose to trade and by chance he may earn a superior return anyway. Of course, if he does trade without information he is equally likely to earn an inferior return, but if this happens the principal cannot penalize him because the agent has no private resources.

An incompetent agent faces the choice between shirking and actively working. If he shirks he will earn k, together with any payment specified in the contract for not trading. Alternatively, if he actively works he can trade at random in the hope of earning a superior return (of course he could instead collect the payment for doing nothing, but then it would be better to shirk and collect k in addition). In other words, if he is not going to trade he might as well get paid twice!

If the principal decides to hire an agent as his portfolio manager, he must design a contract to induce the agent to forego the alternative activity (i.e. to actively work for him), and to maximize the return on the portfolio net of management expenses. The contract cannot condition directly on whether the agent undertakes the alternative activity, nor on whether the agent receives the private information since both of these are unobservable to the principal. However, the contract can condition on the realized value of the security and on the position the agent took.

Note that any contract that attracts incompetents as well as talented managers will result in hiring an incompetent almost surely, since they predominate in the population. Clearly, such a contract will not arise in equilibrium since it entails a positive payment in return for nothing. By the same argument, talented managers under the optimal contract will choose to actively work rather than shirk (if they shirk, they are no better than the incompetents).

Since there is a large supply of talented agents, a portfolio manager will be paid just enough to induce him to forego the alternative activity.

Since the contract cannot condition directly on the agent's type, shirking decision, or on information arrival, the portfolio manager's incentives may be distorted. This may happen even though the contract is optimally designed and attracts only the talented managers. This agency cost may be reflected in the manager trading when he has received no information. We describe this as "noise trade" or "churning."

B. The Security Market

The security is traded in a centralized market where a market maker sets prices and clears the market, and other agents trade for hedging motives. Hedgers should be viewed as a continuum of small traders. However, for convenience we will simply refer to "a hedger" in what follows.

The probability that an agent with a hedging need arrives is δ. With probability $(1 - \delta)$ there is no hedger present.

Hedgers want to insure against an income shock. The income shock may be positively or negatively correlated with the security's liquidation value. With 50 percent probability it will be positively correlated and a hedger will be perfectly hedged by selling one share short. Specifically, the hedger's wealth is W when the asset is worth L and his wealth is worth W + 1 when the asset is worth H. With 50 percent probability a hedger will be perfectly insured by buying one share, that is, his wealth is worth W when the asset is worth H and W + 1 when the asset is worth L. No other agents know whether there is a hedger present, and, if so, whether his hedging need is positive or negative. In other words, in our market the amount of hedgeable risk is either -1, 0, or $+1$ with probabilities $\frac{1}{2}\delta$, $1-\delta$, and $\frac{1}{2}\delta$ respectively.

Since the portfolio managers (averaging over both informed and uninformed) earn excess returns, other agents must be losing money to them. The standard device in the literature (as discussed above in the Introduction) is to model these money-losing agents as "noise" or "liquidity" traders who trade an exogenous random quantity. Rather than introduce such exogenous behaviour, we explicitly model the utility functions of all agents, for two reasons.

First, one goal of our paper is to explain the existence of "noise" trade that is not motivated by informational advantage, risk aversion or liquidity needs. Therefore, we cannot assume the result by introducing exogenous noise trade. We model the trade by agents who are willing to lose money as resulting from an explicit hedging need. When these agents trade they lose money on average, but they are better off because they are partially hedged.

Second, the amount the hedgers trade depends on the equilibrium prices, which in turn depend upon the optimal portfolio management contract and hence the amount of churning. Welfare analysis would be impossible without explicitly modelling the utility functions of all agents. Moreover, our example will depend crucially on the response of hedging demand to the equilibrium prices.

5) Is the discreteness of the hedging demand important?

No. Our hedgers have an income shock of ± 1. One could imagine, as an alternative, an income shock x, where x is a continuously distributed random variable. For example, x could have a Gaussian distribution; this would lead to a continuous (though obviously not Gaussian) distribution of hedging demands. This example illustrates that the closed-form solution of the model would become impossible in general. We chose the simplest distribution of the hedging need for tractability.

6) What is the point of the benchmark model?

Later, we will compare welfare in the model of delegated portfolio management to the benchmark model of direct investment. Our view is that the agency problem is unavoidable. Nevertheless, it is useful to understand the welfare implications of this agency problem by making the comparison with a suitable benchmark.

7) Is the price formation process a critical assumption?

No. We need a price formation process that allows informed traders to earn an excess return at the expense of the uninformed. The market maker institution we use is a common modelling device in the Finance literature.

III. Equilibrium with Delegated Portfolio Management

An equilibrium of the model of delegated portfolio management (DPM) specifies:

1) a decision for the principal on whether to employ an agent to manage his portfolio, and if so, a contract describing the agent's remuneration;

2) a decision for the portfolio manager on whether to shirk or actively work for the principal, and if the latter, a trading strategy (conditional on information arrival);

3) a decision for the hedger on how large a position to take;

such that everybody is maximizing utility, given the market maker's beliefs and the behavior of the others.

$$\max\{\tfrac{1}{2}m_1 + \tfrac{1}{2}m_3, \tfrac{1}{2}m_2 + \tfrac{1}{2}m_4\}.$$

This must be strictly positive since at least one of the m_i ($i = 1, \ldots 5$) must be non-zero, all of them are non-negative and $m_5 = 0$. Therefore if the talented agent receives no information, churning is a strictly dominant strategy. ∎

An optimal contract must satisfy the following two conditions:

$$\max\{\tfrac{1}{2}m_1 + \tfrac{1}{2}m_3, \tfrac{1}{2}m_2 + \tfrac{1}{2}m_4\} < k \tag{2}$$

and

$$\alpha(\tfrac{1}{2}m_1 + \tfrac{1}{2}m_4) + (1 - \alpha)\max\{\tfrac{1}{2}m_1 + \tfrac{1}{2}m_3, \tfrac{1}{2}m_2 + \tfrac{1}{2}m_4\} = k \tag{3}$$

Condition (2) says that the expected payment must be small enough not to attract incompetent managers to actively work at managing portfolios. Since they never receive information, they would then churn. Note that when

$$\tfrac{1}{2}m_1 + \tfrac{1}{2}m_3 = \tfrac{1}{2}m_2 + \tfrac{1}{2}m_4 \tag{4}$$

the uninformed agent will be willing to randomize between buying and selling.

Condition (3) states that the expected payment to the talented manager must be just high enough to attract him away from alternative employment. With probability α he will get information and take the correct investment decision (given that the contract will induce the correct decision in this event). With probability $(1 - \alpha)$ he will not become informed and will churn (recall that the optimal contract cannot specify a strictly positive payment for doing nothing). Since there are many talented managers (even though almost all potential managers are incompetent), the equilibrium expected reward to the manager must be just enough to attract him to actively work.

We can now compute the payments for an optimal contract. We consider symmetric contracts where the payment is the same for both correct outcomes (i.e. $m_1 = m_4$) and also for both incorrect outcomes (i.e. $m_2 = m_3$). Define $m = m_1 = m_4$, and we set $m_2 = m_3 = 0$.

Substituting $m = m_1 = m_4$ and $m_2 = m_3 = 0$ into equation (3) gives:

$$m = 2k/(1+\alpha). \tag{5}$$

This solution satisfies inequality (2) since $\tfrac{1}{2}m < k$.

It is clear that there other contracts that are equivalent in terms of their incentives and their expected costs. Any contract where $m_1 = m_4$, $m_2 = m_3$, $m_1 + m_3 = 2k/(1+\alpha)$ and $m_1 > m_3$ is equivalent so long as m_3 is small enough to satisfy inequality (2). For our purposes this distinction is immaterial.[9]

B. Order Flow in Equilibrium

We now consider the order flow in equilibrium with portfolio management. The hedgers will trade $\pm$ x (the quantity x will be derived below). In order to pool with the hedgers, an informed portfolio manager will also either buy or sell x (any other quantity would reveal his information to the market maker).

Consider the decision problem of an uninformed portfolio manager. If he does not trade, he will be revealed as uninformed. As we showed above, the contract will not reward him in this event, because otherwise it would attract a flood of incompetents. On the other hand if he churns and trades x there are two possible outcomes: first, by luck

We will denote the prices p_S in the event of sell x or 2x, p_0 if no trade, and p_B in the event of buy x or 2x.

D. The Hedger's Decision

Consider the case of a hedger whose income shock is negatively correlated with the security value. When he *buys* x he will pay one of two prices: p_B or p_0. The possibilities are as follows:

1) there is another buyer and the security is worth L. This can only occur if the other buyer is an uninformed portfolio manager who randomly happens to buy (which occurs with probability $\frac{1}{2}\cdot\frac{1}{2}(1-\alpha)) = \frac{1}{4}(1-\alpha)$. Since there is another buyer the price is p_B.

2) there is another buyer and the security is worth H. This can occur if the other buyer, a portfolio manager, is informed (which occurs with probability $\frac{1}{2}\alpha$) or if the other buyer is uninformed and randomly happens to buy (which occurs with probability $\frac{1}{2}\cdot\frac{1}{2}(1-\alpha)$. The probability is, therefore, $\frac{1}{4}(1+\alpha)$. Since there is another buyer the price is p_B.

3) there is another order which is a sell order and the security is worth L. This can occur if the other order was submitted by an informed portfolio manager with bad news (which occurs with probability $\frac{1}{2}\alpha$) or the other order was randomly submitted by an uninformed portfolio manager (which occurs with probability $\frac{1}{2}\cdot\frac{1}{2}(1-\alpha)$). As before the total probability is $\frac{1}{4}(1+\alpha)$. In this case the price is p_0.

4) there is another order which is a sell order and the security is worth H. This occurs if an uninformed portfolio manager randomly submits a sell order (which occurs with probability $\frac{1}{4}(1-\alpha)$). Again, the price is p_0.

The hedger chooses to buy an amount x of the security to maximize:

$$\tfrac{1}{4}(1-\alpha)\, U(W - p_B x + 1) + \tfrac{1}{4}(1+\alpha)\, U(W - p_B x + x) +$$

$$\tfrac{1}{4}(1+\alpha)\, U(W - p_0 x + 1) + \tfrac{1}{4}(1-\alpha)\, U(W - p_0 x + x).$$

Appendix 1 describes the other case of a hedger who sells. Because of the symmetry in the hedger's decision problem, it is optimal to hedge equal but opposite amounts depending on whether the hedger has income shocks which are positively or negatively correlated with the asset value.

E. Out-of-Equilibrium Beliefs and Contract Payments

The contents of this subsection are purely technical but are included for the sake of completeness.

To this point we have only considered the possibility that all agents trade $\pm x$. To complete the construction of the equilibrium, it remains to verify that no agent has an incentive to deviate by trading other quantities. Recall that the market maker's belief is a function of the total quantity traded. The simplest specification of beliefs for the market maker at out-of-equilibrium quantities is that he believes the asset to be worth 1 for any positive (buy) order flow other than x or 2x, and worth 0 for any negative (sell) order flow other than x or 2x.

There are two possible deviations an agent can make. He can trade an amount different from x, but in the right direction (e.g. buy on good news). In this case the price will immediately become fully revealing. Clearly the contract payment will be designed not to induce this trading behaviour (e.g. a payment of zero). Alternatively he can trade in the wrong direction as well a different amount (e.g. sell on good news). In this case the price will be wrong, but so will his position (e.g. he will be short an undervalued asset). Again, the contract will clearly be management. This is because the superior return on a managed portfolio comes at the expense of the hedgers.

G. How Much Noise Trade Can the Market Support?

Substituting for H and L in (6) and defining $\delta^* \equiv 4k/\alpha x$, we have that the market for portfolio money management exists as long as $\delta \geq \delta^*$. Since the expected amount of hedging trade is δx and the amount of expected noise trade is $(1 - \alpha)x$, the ratio of expected noise trade to expected hedging trade is

$$(1 - \alpha)/\delta.$$

Figure 2 illustrates this. As the amount of hedging trade, δ, falls, the ratio of noise trade to hedging trade increases. Furthermore it does so at an increasing rate, $(1 - \alpha)/\delta^2$. In this sense, a "small" amount of hedging can support a "large" amount of noise trade.

IV. Can Noise Trade Make Everybody Better Off?

Noise trading by portfolio managers reduces the profitability of an actively managed portfolio, relative to the benchmark case of direct investment. By the same token, hedgers are effectively able to insure their endowment risk at lower cost. Thus at first glance, it would appear that the noise trade resulting from the agency problem inherent in delegated portfolio management makes hedgers better off and investors worse off.

This conclusion would be too simplistic, however. Because noise trading lowers the effective cost of insurance, hedgers will respond by purchasing more. If the increase in hedging demand (x) is large enough, the investor-principal may actually earn a larger total amount. This is analogous to the standard result in consumer demand theory that, if the price elasticity exceeds 1, a price fall will cause an increase in expenditure.

If the hedgers do respond to delegated portfolio management by increasing their demand sufficiently that the profits on a managed portfolio improve (relative to the benchmark case of direct investment), then the agency problem that generates noise trade will have created a Pareto improvement: hedgers can hedge more cheaply, portfolio managers are indifferent (they are employed at a wage equal to their opportunity cost) and portfolio owners earn higher returns.

In this section, we formalize this argument. We compare an economy with delegated portfolio management to one where there are no agency problems because principals (the owners of the portfolios) have investment management talent, i.e. may become informed with probability α. We provide an example showing a Pareto improvement. Note that this conclusion could not be reached using the standard paradigm of inelastic liquidity demand.

Let x' be hedging demand in the benchmark case of direct investment (DI), and x in the delegated portfolio management case (DPM). We can derive the increase in hedging demand needed to increase the principal's profits:

Lemma 1: *Net profits for the principal are larger with delegated portfolio management than with direct investment if:*

$$x > x'(2 - \alpha - \delta)/(\alpha + \delta - 2\alpha\delta)$$

Proof: In Appendix 2 we solve for the equilibrium in the benchmark case of direct investment by the principal. There, we show that the expected profits of the trader, net of his opportunity cost k, are:

$$\tfrac{1}{4}\alpha x'\delta(2 - \alpha - \delta)/(\alpha + \delta - 2\alpha\delta) - k. \qquad (7)$$

then Delegated Portfolio Management Pareto-dominates Direct Investment.

Proof: We begin by showing in DI, $x' = 0$ is optimal. Expected utility in DI is:

$$\tfrac{1}{2}\alpha W + \tfrac{1}{2}(1-\alpha)[W+x'(1-p_{+1})] +$$
$$\tfrac{1}{2}(1-\alpha)[(W+\tfrac{1}{2})(1-b) - \tfrac{1}{2}\alpha(1-a) + b(W+1-p_{+1}x')] +$$
$$\tfrac{1}{2}\alpha[(W+\tfrac{1}{2})(1-b) - \tfrac{1}{2}\alpha(1-a) + b(W+\tfrac{1}{2})]$$
$$= \tfrac{1}{2}W + \tfrac{1}{2}(1-\alpha)x'(1-p_{+1}) + \tfrac{1}{2}(W+\tfrac{1}{2})(1-b) - \tfrac{1}{4}\alpha(1-a) +$$
$$\tfrac{1}{2}bW + \tfrac{1}{2}b(1-\alpha)(1-p_{+1}x') + \tfrac{1}{4}\alpha b$$

We require that the derivative with respect to x' (from the right hand side at $x' = 0$) be negative, so:

$$\tfrac{1}{2}(1-\alpha)(1-p_{+1}) - \tfrac{1}{2}b(1-\alpha)p_{+1} < 0,$$

i.e.,

$$b > (1-p_{+1})/p_{+1} < 1.$$

Next we compute the expected utility under DPM:

$$\tfrac{1}{4}(1+\alpha)[W+x(1-p_B)] +$$
$$\tfrac{1}{4}(1-\alpha)\{[W + \tfrac{1}{2}(1-\alpha)](1-a) + a(W+1-p_Bx)\} +$$
$$\tfrac{1}{4}(1-\alpha)\{[W + \tfrac{1}{2}(1-\alpha)](1-a) + a(W+\tfrac{1}{2}x)\} +$$
$$\tfrac{1}{4}(1+\alpha)[(W+\tfrac{1}{2})(1-b) - \tfrac{1}{2}\alpha(1-a) + b(W+1-\tfrac{1}{2}x)]$$
$$= \tfrac{1}{4}(1+\alpha)W + \tfrac{1}{2}(1-\alpha)[W+\tfrac{1}{2}(1-\alpha)(1-a)] +$$
$$\tfrac{1}{4}(1+\alpha)[(W+\tfrac{1}{2})(1-b) - \tfrac{1}{2}\alpha(1-a)] +$$
$$\tfrac{1}{4}(1-\alpha)[a(W+1) + aW] + \tfrac{1}{4}(1+\alpha)b(W+1) +$$
$$x\{\tfrac{1}{4}(1+\alpha)(1-p_B) - \tfrac{1}{4}(1-\alpha)ap_B + \tfrac{1}{4}(1-\alpha)\tfrac{1}{2}a - \tfrac{1}{4}(1+\alpha)\tfrac{1}{2}b\}$$

We require that the derivative with respect to x (at $x=1$ from the left-hand side) be positive, i.e.,

$$\tfrac{1}{4}(1-\alpha)a(\tfrac{1}{2}-p_B) + \tfrac{1}{4}(1+\alpha)[1-p_B-\tfrac{1}{2}b] > 0.$$

Now, substituting for $p_B = \tfrac{1}{2}(1+\alpha)$,

$$(1-\alpha)a(-\tfrac{1}{2}\alpha) + (1+\alpha)[\tfrac{1}{2}(1-\alpha)-\tfrac{1}{2}b] > 0,$$

or,

$$b < (1-\alpha) - a\alpha(1-\alpha)/(1+\alpha).$$

churning would be a public good (we discuss this further below).

B. What additional welfare implications would arise if the informativeness of asset prices mattered?

An obvious omission from our analysis is any benefit from more informative prices. It is generally accepted (although it has rarely been explicitly modelled) that more informative prices in secondary securities markets are better because they lead to more efficient resource allocation. Our model ignores this effect. At first glance, more noise makes prices less informative. If the price is used to guide resource allocation, this effect would therefore counteract the effect in our welfare example. However, as the original insight of Grossman and Stiglitz (1976, 1980) showed, more noise can allow more (costly) information production to become profitable. The overall effect is therefore ambiguous.

C. Is it surprising that an agency problem can be beneficial to the principal?

In our model the agency problem for the portfolio owner can end up (as in the example) making him better off. While this may seem paradoxical it is analogous to the fact that less information or more constraints in a decision problem can sometimes help an agent in a game-theoretic environment. This is a standard result; see for example, the discussion of Stackelberg and Cournot duopoly in Gibbons (1992).

D. Can noise trade be a public good?

In the extreme, the lemons problems caused by the presence of informed traders may cause a market to fail to exist. Indeed, our example illustrates this possibility.[10] Churning, then, may cause the market to open (as in our example). A similar problem was shown in Pagano (1989). His model may have more than one equilibrium, each with a different amount of shares in existence. In a "thin" equilibrium (i.e. a small number of shares in existence), risk-averse agents are unwilling to trade because of the risk that there will be few buyers when they need to sell. In a "thick" equilibrium this problem disappears.

Opening new markets, or keeping an existing market open, often requires subsidizing trade. This can occur in at least two ways. First, an agent may be paid to trade, or be willing to absorb a trading loss. Second, an agent making a market in a security may be willing to post prices with an unprofitably narrow bid-ask spread in order to induce uninformed trade. While in the second case there is no actual noise trade, there is a similar effect of lowering the price impact of a trade. In both cases, the smaller price response induces a larger volume of uninformed trade. In fact, subsidization of market making, rather than of noise trading, is simply a more direct method of creating liquidity.

To illustrate we give two examples. On the New York Stock Exchange, specialists are often assigned smaller, less liquid stocks in addition to the stock of a large-capitalization firm. The implicit understanding is that some monopoly profits from making a market in the large stock will be used to subsidize a lower bid-ask spread in the small-capitalization stock. Another example was Drexel Burnham Lambert's support of the junk-bond market. Apparently Drexel was willing to create liquidity in the secondary junk bond market, perhaps at a loss, in order to profit from underwriting in the primary market.

E. How does portfolio management differ from direct sale of information?

Instead of managing the portfolio, the agent could simply make trading recommendations. The principal could then manage the portfolio on the basis of this recommendation, making a payment to the agent depending on the accuracy of the recommendation. We have not directly addressed the question of how this differs from the agent combining the roles of information production and portfolio management. As discussed in subsection H, below, there is a literature which treats these two situations as economically equivalent.

traders) trade in a market with a price bubble. The bubble is an exogenous price process whose role is to allow uninformed managers to carry out negative-present-value risky trades, as in this paper.

Trueman (1988) is a model of portfolio management where churning may occur. In his model, the relationship between manager and investor is not modelled. Instead, it is assumed that the objective function of the agent is (essentially) to maximize the posterior belief of an observer (e.g. the investor) that he will receive information. Churning occurs because if it did not, any trade would signal that the manager was informed. In other words, one cannot have a separating equilibrium where uninformed managers make no attempt to imitate the informed. This problem could be overcome by the incentives of a suitably designed contract. This issue is one of the starting point of our paper.

There are a number of other papers that consider the contracting problem of buying information from an agent. This issue is tangentially related because these models treat information sale as isomorphic to portfolio management. See the discussion in Allen (1989) and the references therein, e.g. Allen (1990), Bhattacharya and Pfleiderer (1985), Kihlstrom (1988). These models do not imply churning (i.e. reporting false signals) because the agents can effectively be punished sufficiently hard to deter churning/lying. In our model, this possibility is precluded by the (binding) constraints of limited liability and limited personal resources of the agent. These models of information sale also do not consider the effect of the agency problem on security market prices or trading volume.

In our model, unlike the above models, the direct sale of information by a potentially informed agent to an investor is different from an agreement under which the agent actually trades with the investor's portfolio. The reason for this is that, in our setting, agents can accept contracts to produce information without foregoing their reservation wage. In other words, an uninformed agent has nothing to lose by accepting such a contract. Any such contract would therefore attract a flood of incompetents.

VI. Conclusion

A portfolio manager will frequently find that the best investment policy is simply to hold the existing portfolio. In other words, to do nothing. The question is whether, in this situation, he will be able to credibly convince his client or employer that he is "actively" doing nothing. The client may instead believe that he is simply doing nothing. He may think that the portfolio manager has not spent any effort on producing information or he has no talent. Our paper describes a contractual relationship, and its economic consequences, where actively doing nothing is indistinguishable from simply doing nothing. Ultimately it is an empirical question as to when these are indistinguishable. Designing a contractual relationship for portfolio management is to a large extent a matter of maximizing this distinction.

Noise trade is a manifestation of this agency problem. Because all our agents' objectives are specified we can examine the welfare implications of this agency problem. Our example shows that noise trade, by making the market more liquid, can benefit everyone. This illustrates that welfare effects can be more subtle and more complex than is allowed by standard models with exogenous noise traders.

Appendix 2: Equilibrium with Direct Investment

A2.1 Order Flow under Direct Investment

As before, orders must be multiples of x' since that is the amount the hedger will trade if he arrives. The market maker will observe five possible order flows:

Sell $2x'$: This occurs if there is both an informed agent who sells and a hedger who sells.

Sell x': This occurs if there is either an informed agent who sells (and no hedger) or a hedger who sells (and the agent does not receive information).

No trade: If no hedger arrives and the agent does not learn any information; or if a hedger arrives to sell and the informed agent learns that the security is of high value and buys or vice versa.

Buy x': This is symmetric to selling x'.

Buy $2x'$: This is symmetric to selling $2x'$.

A2.2 Prices and Beliefs

The market maker's beliefs (and the prices) in these five cases are:

Sell $2x'$: The true value of the security is revealed so the market maker's belief that the asset is worth 1 is zero and the price is also zero. We denote this price by p_{-2}. The probability of this event is $\frac{1}{4}\alpha\delta$.

Sell x': The probability of this event is:

$$\tfrac{1}{2}\alpha(1-\delta) + \tfrac{1}{2}(1-\alpha)\delta,$$

and the probability of the joint event of sell x' and the asset is valuable is:

$$\tfrac{1}{4}(1-\alpha)\delta.$$

Therefore, the market maker's belief about the value of the asset when he observes a single sell order is:

$$\delta(1-\alpha)/2(\alpha+\delta-2\alpha\delta)$$

which is the price. We denote this price by p_{-1}.

No trade: This conveys no information (by symmetry) so the price, p_0, is the unconditional expectation, $\frac{1}{2}$. The probability of this event is $1-\alpha-\delta+(3/2)\alpha\delta$.

Buy x': The probability of buying x' is

$$\tfrac{1}{2}\alpha(1-\delta) + \tfrac{1}{2}(1-\alpha)\delta.$$

The probability of buying x' and the asset is highly valued is:

$$\tfrac{1}{2}\alpha(1-\delta) + \tfrac{1}{4}(1-\alpha)\delta.$$

Case 3: There is no other order and the asset is worth 1. There will be no other order only if there is no informed trader in which case the asset is equally likely to be worth 1 or 0. The wealth of the hedger is $W - p_{+1}x' + x'$ and the probability of this event is $\frac{1}{2}(1 - \alpha)$.

Case 4: There is a sell order and the asset is worth 0. This occurs if the informed trader sells the asset in which case the price is p_0 and the wealth of the hedger is $W - p_0x' + 1$. This event occurs with probability $\frac{1}{2}\alpha$.

The utility of the hedger is given by:

$$\tfrac{1}{2}\alpha U[W] + \tfrac{1}{2}(1 - \alpha)U[W + 1 - x'p_{+1}]$$

$$+ \tfrac{1}{2}(1 - \alpha)U[W + x'(1 - p_{+1})] + \tfrac{1}{2}\alpha U[W + 1 - \tfrac{1}{2}x']$$

The utility of a hedger whose wealth is positively correlated with the asset value can be similarly derived. It turns out to be the same function as above so that the choice of x' for buying and selling hedgers is the same.

The derivative of expected utility with respect to x' is:

$$+ \tfrac{1}{2}(1 - \alpha)U'[W + 1 - x'p_{+1}](-p_{+1})$$

$$+ \tfrac{1}{2}(1 - \alpha)U'[W + x'(1 - p_{+1})](1 - p_{+1}) + \tfrac{1}{2}\alpha U'[W + 1 - \tfrac{1}{2}x'](-\tfrac{1}{2}).$$

Evaluating at $x' = 0$ and setting the derivative to be positive gives:

$$U'(W)/U'(W+1) > [\tfrac{1}{2}\alpha + (1 - \alpha)p_{+1}]/[(1 - \alpha)(1 - p_{+1})]$$

which is the condition for non-zero hedging in the case of direct investment. Note that $p_{+1} = (2\alpha + \delta - 3\alpha\delta)/2(\alpha + \delta - 2\alpha\delta)$; it may be verified that this condition is more stringent than the corresponding condition under delegated portfolio management (see Appendix 1).

References

Allen, Franklin (1989), "Information Contracting in Financial Markets," in Sudipto Bhattacharya and George M. Constantinides, eds., *Financial Markets and Incomplete Information* (Rowman and Littlefield publishers; Totowa, New Jersey), p. 188-198.

Allen, Franklin (1990), "The Market for Information and the Origin of Financial Intermediation," *Journal of Financial Intermediation* 1: 3-30.

Allen, Franklin and Gary Gorton (1993), "Churning Bubbles," *Review of Economic Studies* 60(4): 813-836.

Ausubel, L. (1990a), "Partially-Revealing Rational Expectations Equilibrium in a Competitive Economy," *Journal of Economic Theory* 50: 93-126.

Ausubel, L. (1990b), "Insider Trading in a Rational Expectations Economy," *American Economic Review* 80: 1022-1041.

Bank for International Settlements (1993), Central Bank Survey of Foreign Exchange Market Activity in April 1993 (March; Basle).

Bhattacharya, S. and P. Pfleiderer (1985), "Delegated Portfolio Management," *Journal of Economic Theory* 36: 1-25.

Biais, Bruno and Pierre Hillion (1992), "Insider Trading and Stock Options Markets," Groupe HEC working paper.

Black, Fischer (1986), "Noise," *Journal of Finance* 41(3): 529-543.

De Long, Bradford, Andrei Shleifer, Lawrence Summers and Robert Waldman (1990), "Noise Trader Risk in Financial Markets," *Journal of Political Economy* 98: 703-738.

Diamond, D. and Verrechia, R. (1981), "Information Aggregation in a Noisy Rational Expectations Economy," *Journal of Financial Economics* 9: 221-35.

Dow, James and Gary Gorton (1994a), "Arbitrage Chains," *Journal of Finance* (July), forthcoming.

Dow, James and Gary Gorton (1994b), "Profitable Informed Trading in a Simple General Equilibrium Model of Asset Pricing," working paper.

Gibbons, Robert (1992), *A Primer on Game Theory* (Harvester Wheatsheaf).

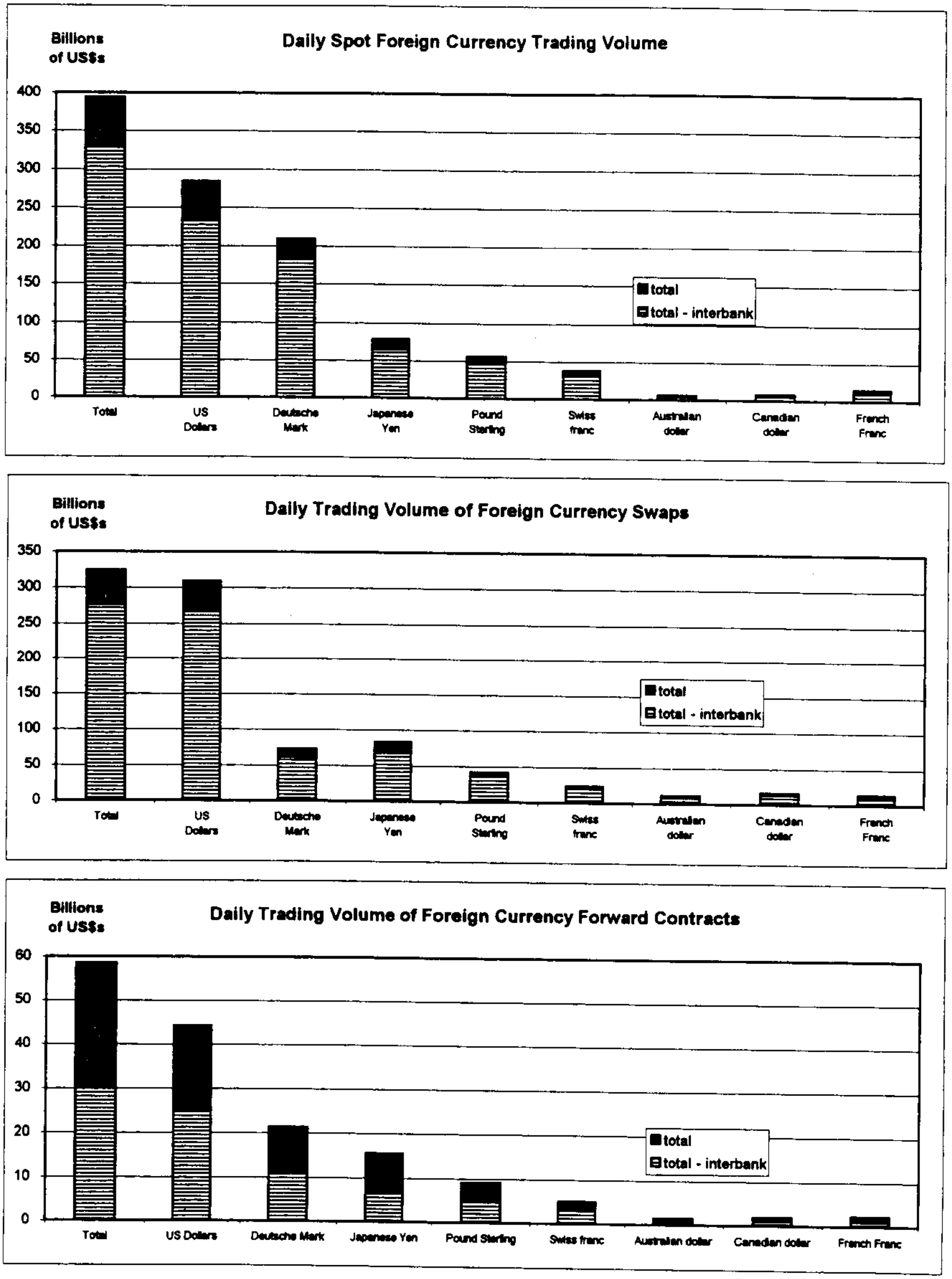
Grossman, S. G. and J. E. Stiglitz (1976), "Information and Competitive Price Systems," *American Economic Review* 66: 246-253.

Grossman, Sanford and Joseph Stiglitz (1980), "On the Impossibility of Informationally Efficient Markets," *American Economic Review* 70: 393-408.

Holmstrom, Bengt (1982), "Managerial Incentive Problems: a Dynamic Perspective," in *Essays in Economics and Management in Honor of Lars Wahlbeck.*

Kihlstrom, Richard (1988), "Optimal Contracts for Security Analysts and Portfolio Managers," *Studies in Banking and Finance* 5: 291-325.

Figure 1: Foreign Exchange Trading Volume



Source: Bank for International Settlements (1993).

Figure 3

Parameter Region Where Delegated Portfolio Management Dominates Direct Investment