American Finance Association

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Author(s): Paul E. Fischer
Source: *The Journal of Finance*, Vol. 47, No. 2 (Jun., 1992), pp. 673-694
Published by: Blackwell Publishing for the American Finance Association
Stable URL: http://www.jstor.org/stable/2329119
Accessed: 25/11/2009 11:46

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THE JOURNAL OF FINANCE • VOL. XLVII, NO. 2 • JUNE 1992

Optimal Contracting and Insider Trading Restrictions

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ABSTRACT

Restrictions on trading by insider agents are analyzed using an optimal contracting framework. Prohibition of insider trading is shown to be Pareto preferred if, and only if, a revelation or moral hazard problem exists. If prohibition of insider trading is valuable, then trade registration with a delay is shown to be as valuable as complete prohibition. Short selling restrictions, however, are generally of less value than complete prohibition. Finally, regulation of insider agent trading by governmental institutions and/or professional associations is discussed.

LEGISLATORS, MARKET PARTICIPANTS, AND scholars in both law and economics have grappled with the issue of what classes of insiders, if any, should face security trading restrictions. This paper analyzes the value of prohibiting trading by one class of insiders.[1] In addition, the value of other types of trading restrictions are compared with a trading prohibition. Finally, the roles of professional associations and government institutions are considered.

The specific class of insiders considered are individuals who obtain inside information about a particular firm as a result of providing some service to the firm in question. This class of insiders, who will be called agents, include the firm's employees, external accountants, investment bankers, attorneys, and even major suppliers. In reality, agents are subject to a number of restrictions on their securities trading activity. Some of these restrictions originate in the public sector. For instance, a firm's directors and officers are required to report trading activity, are not allowed to retain short swing profits (any profits earned by buying and selling over a six-month period), and are restricted from making short sales by the Securities and Exchange Act of 1934. Common law rules also apply to these insiders.[2] Under common

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[1] When the word value is used in this paper, it means value in a Pareto sense.

[2] A summary of common law rules applying to trading by insider agents is contained in Carlton and Fischel (1983).

law rules, fiduciary duties prohibit a firm's agents from utilizing or publicly misrepresenting inside information in a manner that is detrimental to the firm. Such rules imply that agents may not earn insider trading profits at the expense of the firm's shareholders.

Other restrictions originate in the private sector. Public accountants have formed associations, such as the American Institute of Certified Public Accountants, to enforce their commitments not to trade the securities of their clients. Accounting firms, law firms, and investment banking firms also have internal monitoring systems to support commitments not to engage in insider trading activities. From a positive economic standpoint and a policy perspective, it is important to identify why such restrictions may be optimal, which restrictions may be redundant, and why the complex mechanisms just described are used to implement optimal restrictions.

The analysis of insider trading in this paper utilizes an optimal contracting approach. This approach was originally advocated by Manne (1966) and later by Carlton and Fischel (1983). These authors were among the first to point out that the ability of an agent to exploit his informational advantage can be part of an explicit or implicit contract between the shareholders and the agent. Specifically, the agent exchanges his productive services for a compensation package that may include compensation earned from insider trading. Neither Manne (1966) nor Carlton and Fischel (1983), however, formally address the common arguments offered as to why trading restrictions are valuable. Furthermore, neither considers the value of more limited forms of trading restrictions. Finally, neither deals with the issue of how valuable agent trading restrictions are credibly implemented.

A number of potential benefits arising from restricting agent trading are noted in the insider trading literature. Many of these potential benefits are associated with one of three arguments. First, compensating an agent by allocating him insider trading rights is inefficient because risk is imposed on the agent with little or no corresponding incentive benefit (i.e., inside information is received by the agent regardless of the actions they take (Easterbrook (1981)). Second, permitting agent trading is inefficient because incentives are created for the agent to improperly report information to the market. Third, permitting agent trading is inefficient because incentives are created for the agent to take actions that are not in the interest of shareholders (Easterbrook (1981)). Each of these three arguments is explored using the principal-agent framework.

Within the context of the agency model presented here, where direct communication, complete contingent contracting, and enforcement of insider trading restrictions are costless, insider trading restrictions are shown to be valueless if there are no other agency-related problems. In this setting, any potential gains to the agent can be undone by shareholders in the contracting phase by adjusting the insider agent's compensation contract. This result does not require that agent trades ever become public information. This finding runs counter to the argument that allocating insider trading rights is inherently inefficient because unnecessary risk is imposed on the agent.

If agency-related information asymmetries exist, such as revelation and moral hazard problems, then prohibiting agent trading may be valuable. This result is consistent with the claim that agent trading is inefficient because incentives are created for the agent to improperly report information to the market and to take actions that are not in the interest of shareholders. The efficiency attributable to agent trading arises because shareholders must take into account the fact that, when an agent is allowed to trade the firm's securities, another dimension is added to the agent's unobservable strategy space. The expansion of the agent's strategy space requires that the shareholders alter optimal contracts in a costly manner.

Since some of the observed restrictions on agent trading do not involve a trading prohibition, other forms of restrictions are also examined. Trade registration with delay is shown to be sufficient to allow replication of the allocation attained under complete prohibition. Trade registration supports the allocation attained under complete prohibition because it permits contracting on agent trades by making the trades observable. Contracting on the agent trades makes it possible for shareholders to specify the agent's trading strategy costlessly. On the other hand, a restriction on short selling is shown to be insufficient to permit replication of the allocation attained under complete prohibition. The restriction on short selling is insufficient because it only partially restricts the agent's trading opportunities.[3]

Finally, the implementation of insider trading restrictions by professional associations and governmental institutions is discussed. An extended version of the model is used to illustrate that governmental institutions or professional organizations may be needed if optimal insider trading restrictions are to be credibly implemented. The model demonstrates that, if agent contracts are not public information, optimal insider trading restrictions may not be implemented in a simple competitive market. The failure to implement desirable insider trading restrictions occurs because the shareholders who contract with an agent do not endogenize the costs of agent trading that are incurred by future shareholders. This illustration provides a reason why governmental institutions or professional associations enact and enforce insider trading restrictions.

A number of papers have dealt with other aspects of the insider trading issue that are not explicitly addressed in this paper. Manne (1966), Carlton and Fischel (1983), and Dye (1984) suggest that trading by agents may be socially beneficial in a principal-agent context because such trading allows an agent to renegotiate contracts when underlying conditions change. Implicit in this view is the assumption that direct communication or complete contracting is prohibitively costly. This assumption is not maintained in this paper and no communication value arises. Furthermore, given the results in

[3] These results suggest that multiple trading restrictions may be redundant. It should be noted that one reason multiple restrictions may be valuable is due to the possibility that combinations of insider trading restrictions may decrease contracting costs by allowing some state contingent compensation to come implicitly from insider trading.

this paper, other communication mechanisms are probably more appropriate than communication via insider trading.

Other papers deal with the impact of insider trading restrictions on market efficiency. Manne (1966) and Carlton and Fischel (1983) claim that permitting insider trading creates a more informationally efficient market which results in a more efficient allocation of resources. This claim may be questionable for two reasons. First, is the market necessarily more efficient when insider trading is permitted? Second, if insider trading results in a more efficient market, is permitting insider trading necessarily of social value? The first question is addressed in Fishman and Hagerty (1989). They present a model which shows that agent trading may make the security market less efficient. In their model agent trading discourages outsiders from gathering information. Therefore, permitting agent trading may decrease efficiency because the efficiency gains arising from agent trading may be offset by efficiency losses arising from less trading by informed outsiders.

The second question is addressed from two perspectives. Hirshleifer (1971) and Marshall (1974) provide an implicit argument that insider trading may be socially detrimental because individuals have incentives to waste resources obtaining inside information that has no social value. Instead of focusing on the information acquisition costs associated with insider trading, other authors focus on the effects of insider trading on investment decisions. One argument put forward states that insider trading discourages investment because outsiders expect to lose to insiders in subsequent security trades (see Ausubel (1990) and Manove (1989)). A counter argument states that the information revealed through insider trading reduces average investment risk and, consequently, results in higher average investment (Leland (1990)). Bernhardt, Hollifield, and Hughson (1990) consider a model where investment decisions are simultaneously improved and worsened as a consequence of insider trading. In their model, insider trading is socially beneficial because it improves future investment decisions by uninformed traders, but it is socially costly because it distorts uninformed traders' current investment decisions toward those assets with less private information.

Finally, some prior literature relates insider trading to market liquidity. If liquidity is measured by the impact of a liquidity trade on price, Glosten (1989) and Leland (1990) show that insider trading may decrease liquidity. In these models, a decrease in liquidity occurs because liquidity trades are indistinguishable from insider trades. Consequently, liquidity trades are treated as possible insider trades and the market price adjusts to reflect that possibility.

The remainder of the paper proceeds as follows. Section I contains a specification of the model. Section II contains an analysis of the value of prohibiting trading by agents in three different contracting environments: one with no agency problems, one with a revelation problem, and one with the traditional moral hazard problem. Section III considers some alternative restrictions on agent trading. Implementation of trading restrictions is considered in Section IV. Section V summarizes the results.

I. The Model

The model involves shareholders and a fiduciary agent, hereafter called the agent, who is employed at the production facility owned by the shareholders. Although the model is quite primitive, it captures the three previously cited potential sources of inefficiency arising from agent trading of the firm's securities. First, the agent may receive uncertain compensation from insider trading that results in suboptimal risk sharing. Second, the agent may have incentives to misreport information to shareholders in order to create profitable trading opportunities. Finally, the agent may have incentives to take actions that are not in the shareholders' interests because of the profitable trading opportunities such actions create.

A. An Overview

Consider a model with two types of individuals: shareholders and an agent. The shareholders' objective is to maximize the total expected return from their collective investments in a firm where returns are measured in units of consumption. The shareholders offer the agent a contract to undertake certain activities that affect the distribution of returns to the firm's capital. The agent's utility function is separable and denoted $u(c) - f(a)$ where c is consumption, a is some action, $u' > 0$, $u'' < 0$, $f' \geq 0$, and $f'' \geq 0$. The agent agrees to a contract offered by the shareholders if it yields at least a reservation level of expected utility denoted U.

B. Sequence of Events

The model's time sequence of events is summarized in Table I. At $t = 0$, where t denotes time, the agent contracts with the shareholders. At $t = 1$, he chooses an action from some finite set. Elements of the set of actions are denoted as a or α. These actions could be effort levels, capital allocations, perquisite expenditures, or information production expenditures. The agent's action is contemporaneously unobservable and, depending on the particular case being considered, may or may not be costlessly verified by the shareholders. The action affects the probability distribution of the gross return, x. The set of possible xs is finite.

At $t = 2$ the agent privately observes a signal, y, whose probability distribution may be a function of the agent's action. The set of possible ys is finite. The signal y contains information about x and is the source of the agent's inside information.

A security market opens at time 3 where the firm's shares are traded by the shareholders, a market maker, and, in some cases, the agent. No other individuals are active in the security market. One share pays 100% of the firm's net return and is completely divisible. Purchases and sales are denoted in percent of the firm's net return. Share prices are denominated in units of final consumption. If the agent is permitted to trade the firm's securities, the $t = 3$ security market provides the agent with an opportunity to exploit his inside information y. At this time, aggregate liquidity sales, S_3, and aggre-

Table I
Sequence of Events

Time (t)	Event
0	Shareholders contract with agent
1	Agent takes action
2	y realized and observed by agent
3	Security market trading
4	Agent reports y
5	Security market trading
6	x realized and observed by shareholders and agent
7	Contracts settled (compensation and security market)
8	Consumption occurs

gate liquidity purchases, P_3, are made by the shareholders. The values S_3 and P_3 are random variables and are independent of $\{x, y\}$.

The structure of the security market is similar to the market modeled in Glosten and Milgrom (1985) and Admati and Pfleiderer (1989). The market is intermediated by a risk neutral market maker. Market making is assumed to be perfectly competitive and, consequently, the market maker sets the bid price, B_3, and the ask price, A_3, to yield a zero expected profit on purchases and sales. Unlike the models in Grossman and Stiglitz (1976), Kyle (1985), and Admati and Pfleiderer (1988), the security prices are not conditional on trading volumes. None of the propositions in this paper would likely be altered if the agent's utility function and the market structure conformed to the Kyle (1985) or Admati and Pfleiderer (1989) models.

If the agent is allowed to trade in the security market, he can trade anonymously. If the agent can trade, however, he is restricted from holding a net long position exceeding u_l or a short position exceeding u_s. This assumption is justifiable on the grounds that if the agent exceeds some bound, he will likely face a credit constraint that can only be relaxed by revealing his information and trading positions to all creditors and, thus, to the market. Agent trading strategies are denoted w or ω where w denotes the optimal trading strategy and ω denotes a suboptimal trading strategy. Optimal sales (purchases) by the agent at $t = 3$ are denoted $s_3(y)$ $(p_3(y))$ and are a function of the signal, y, as well as the relevant nonrandom variables.

Signal y is reported at $t = 4$.[4] This report, depending on the case being considered, may or may not be costlessly verified ex post. Reporting strate-

[4] If the agent is prohibited from security trading, the signal has no explicit ex ante social value to risk neutral shareholders because it results in expected net transfers of 0. Therefore, this signal could be thought of as a financial statement which is of value because it provides information regarding the productive activities of other agents hired by the shareholders (see Fischer (1989)), because it allows the shareholder to take some optimal actions with respect to the firm or because it may decrease incentives of individual shareholders to expend resources to obtain inside information (see Diamond (1985)).

gies of the agent are denoted as r or ρ where r represents the truthful reporting strategy and ρ represents a nontruthful reporting strategy. The revelation principle (Harris and Townsend (1981)) applies in this setting, and r is treated as the reporting strategy desired by the shareholders. The reporting strategies are simply mappings from the set of signals into the set of signals. Since the set of signals is finite, the set of feasible pure reporting strategies is finite.

The security market is again open at $t = 5$ and has notation analogous to the $t = 3$ market with the exception that bid and ask prices may be conditioned on the y reported. If the agent is permitted to trade the firm's securities and if there is a revelation or moral hazard problem, the $t = 5$ market provides an opportunity for the agent to make trades at distorted prices by altering reporting or action strategies. At $t = 6$, x is realized and publicly observed. At $t = 7$ contracts are settled. Activity concludes at $t = 8$ when consumption takes place.

C. A General Optimal Contracting Problem

The shareholders' optimal contracting problem in this model is to choose $\{a, r, w\}$ and an agent compensation package to maximize their returns from investments in the firm. The compensation package must allow the agent to attain his reservation level of expected utility, U, through direct compensation and security trading profits. In addition, the compensation package must provide the agent, if necessary, with incentives to choose the optimal action, reporting, and trading strategy.

The state contingent compensation levels are denoted c_i where each $i \in I$ represents the joint outcome of the observed variables $\{x, y\}$.[5] Note that the y associated with each i is the y reported by the agent and not necessarily the y observed by the agent. $\pi_i(\cdot)$ represents the unconditional probability of i given the agent's action, reporting and trading strategy choice. $\pi_{i|y}(\cdot)$ represents the probability of i conditioned on the signal reported given the agent's action, reporting, and trading strategy.

The shareholders' decision problem is as follows.

Maximize with respect to a, w, c_i

$$\sum_{i \in I} \big[(x - c_i) + S_3\big(B_3 - (x - c_i)\big) + S_5\big(B_5(y) - (x - c_i)\big) + P_3\big((x - c_i) - A_3\big) + P_5\big((x - c_i) - A_5(y)\big)\big]\pi_i(a, r, w) \quad (1)$$

[5] It should be acknowledged that trading volumes are signals of agent trading activity and, consequently, volume-contingent contracts may be superior to the contracts considered in the paper. In a previous version of the paper, volume-contingent contracting is considered. As long as the liquidity sales and purchases are unbounded so that trading volumes never perfectly reveal agent trading activity, none of the results obtained are altered if contracts are conditioned upon trading volume.

Subject to:

$$U - \sum_{i \in I} u(c_i + e_i(w))\pi_i(a, r, w) - f(a) \leq 0. \tag{2}$$

$$\{a, r, w\} = \underset{\sigma}{\operatorname{argmax}} \left\{ \sum_{i \in I} u(c_i + e_i(\omega))\pi_i(\alpha, \rho, \omega) - f(\alpha) \right\} \tag{3}$$

$$\sum_{i \in I} (P_3 + p_3(y))(A_3 - (x - c_i))\pi_i(a, r, w) = 0 \tag{4}$$

$$\sum_{i \in I} (S_3 + s_3(y))((x - c_i) - B_3)\pi_i(a, r, w) = 0 \tag{5}$$

$$\sum_{i \in I} (P_5 + p_5(y))(A_5(y) - (x - c_i))\pi_{i|y}(a, r, w) = 0 \tag{6}$$

$$\sum_{i \in I} (S_5 + s_5(y))((x - c_i) - B_5(y))\pi_{i|y}(a, r, w) = 0 \tag{7}$$

The first term in the objective function, (1), represents the return from the shareholders' original capital investment. The four remaining terms represent the returns from their liquidity trades. The agent's reservation utility constraint, (2), incorporates total trading profits (losses) the agent incurs in state i, $e_i(w)$, where

$$\begin{aligned} e_i(w) = {} & s_3(y)(B_3 - (x - c_i)) + p_3(y)((x - c_i) - A_3) \\ & + s_5(y)(B_5(y) - (x - c_i)) + p_5(y)((x - c_i) - A_5(y)). \end{aligned} \tag{8}$$

In general, $e_i(\omega)$ represents the profits (losses) the agent incurs in state i when he chooses trading strategy ω, and the shareholders and market maker believe the agent has chosen the strategy triple $\{a, r, w\}$.

In the incentive constraint, (3), σ represents the agent's strategy space which varies with the environment being considered. For instance, if the agent's report is costlessly verified, agent actions are unobservable, and agent trading is permitted, then σ contains reporting strategy r and all feasible action and trading strategy combinations. The remaining four equations are the equilibrium pricing conditions which guarantee the market maker expected returns of zero.

D. The Costs of Enforcing Insider Trading Restrictions

Throughout the remainder of the paper the values of various agent trading restrictions are analyzed by using specific variations of the shareholders' decision problem. Any analysis of a trading restriction's value requires a specification of the cost of enforcement. Throughout this paper, the cost of enforcing any restriction is assumed to be zero. Carlton and Fischel (1983) have suggested that the cost of enforcing insider trading restrictions may outweigh any benefits of such a restriction.

II. Optimal Contracting and the Value of Prohibiting Agent Trading

Three reasons why insider trading restrictions might have value were noted above: compensating agents by allocating them insider trading rights is inherently inefficient because risk is imposed upon the agents with no corresponding incentive benefits; permitting agents to trade on inside information is inefficient because the agents are provided with greater incentives to improperly report valuable information; and permitting agents to trade on inside information is inefficient because the agents are provided with greater incentives to take actions that are not in the interest of shareholders.

The shareholders' decision problem is used to determine if prohibiting agent security trading permits the shareholders to write contracts that yield Pareto superior allocations. These variations are created by exogenously restricting the action and reporting components of the agent's strategy space. Restricting the agent's strategy space is formally identical to assuming that part of the agent's strategy is costlessly verifiable. The first reason is analyzed by exogenously restricting σ so that the agent's only action and reporting choice is that desired by the shareholders, $\{a, r\}$. The second reason is analyzed by exogenously restricting σ so that the agent's only action choice is a. The third reason is analyzed by exogenously restricting σ so that the agent's reporting choice is r.

A. Implicit Costs Associated with Insider Trading Restrictions

As noted earlier, one argument in support of insider trading is that insider trading transmits valuable inside information to the market. In some cases, the value of the information may outweigh the costs of insider trading. Proposition 1 states that, within the context of the model in this paper, no such benefits arise even if the agent's trading strategy space is exogenously restricted. There are no benefits because complete communication and complete contracting are feasible in the model. It should be noted that Proposition 1 holds for any specification of the set of agent action and reporting strategies (i.e., Proposition 1 holds when moral hazard and revelation problems do and do not exist) and that Proposition 1 holds regardless of the restrictions placed on the set of agent trading strategies.

Proposition 1: *The allocation attained when the agent cannot trade always weakly dominates the allocation attained with any agent trading strategy.*

Proof: See the appendix.

B. Necessary and Sufficient Conditions for Insider Trading Restrictions to Have Social Value

Proposition 1 shows that there are no opportunity costs associated with restricting insider trading by the agent. Proposition 2 establishes a necessary condition for such restrictions to have social value in the model being analyzed.

Proposition 2: *There exist parameterizations of the model such that the allocation attained when the agent cannot trade strictly dominates the allocation attained when the agent can trade if, and only if, σ contains multiple action or reporting choices.*

Proof: See the appendix.

Proposition 2 implies that a prohibition on agent trading is valuable only when a moral hazard or revelation problem is present.

Proposition 2 has implications regarding the three alleged benefits of insider trading restrictions noted previously. First, insider trading restrictions are valueless in the absence of other agency problems. Therefore, compensation via allocation of insider trading rights is not inherently inefficient. The intuition supporting the proof of this *only if* component of the proposition is quite straightforward. In the setting where the agent is prohibited from trading, and agent's reports and actions are costlessly verified, the optimal compensation contract is a fixed payment. When the agent is allowed to trade, the shareholders effectively pay the agent both direct and indirect compensation, where indirect compensation takes the form of insider trading profits. The indirect compensation cost is passed on to the shareholders from the market maker through increased bid/ask spreads. The shareholders optimally design the direct form of compensation so that, given the optimal trading strategy, the agent ultimately receives a fixed amount of consumption good in all states. This is done by paying the agent less direct compensation for signals that yield greater insider trading profits.

Second, the *if* portion of the proposition indicates that, in the presence of traditional revelation or moral hazard problems, trading restrictions may have value. Thus, the other two alleged benefits of insider trading restrictions noted above are consistent with the model. The value of the trading restriction arises because agent trading adds binding constraints to the optimal contracting problem of the shareholders.

Formally, the proof to the *if* part of the proposition is done by generating counter examples. The counter examples associated with the revelation problem are developed using a simple two-signal, three-return state economy. For a continuum of parameterizations of this economy, any contract that unravels agent trading profits when the agent makes truthful reports and trades optimally, fails to provide incentives for the agent to truthfully report his signal. The failure to satisfy the truth-telling constraints arises because the agent can purchase or sell securities at favorable prices at $t = 5$ by making false reports at $t = 4$. For instance, when the signal realized indicates a high expected return, the agent may report a signal that indicates a low expected return in order to lower the asking price for his $t = 5$ purchases.

With respect to the moral hazard problem, the set of counter examples is constructed using a two-signal, two-return, three-action economy. Again, for a continuum of parameterizations of this economy, any contract that unravels agent trading profits when the agent acts and trades optimally, fails to provide incentives for the agent to take the optimal action. The failure to satisfy the incentive constraints for the agent action choice arises because the agent may choose undesirable actions in order to increase the value of his insider trading rights. For instance, an agent may choose investment projects that yield extreme signals because the agent can earn larger trading profits when signal reports generate significant swings in the security price.

C. The Robustness of Proposition 2

Proposition 2 indicates that a trading prohibition has no value in the absence of revelation or moral hazard problems. The result arises because the shareholders always learn of the agent's information advantage prior to the payment of direct compensation. They use the information to infer the insider trading profits obtained by the agent and then they adjust the agent's compensation so that his final consumption is independent of those profits. Furthermore, the shareholders do not care about the impact of agent trading on the bid/ask spread since they are risk neutral and their ex ante expected return is not influenced by that impact. This intuition suggests that relaxing some of the model's assumptions would probably negate the *only if* part of Proposition 2. The implications of changing two of the model's assumptions are discussed below.

The first alteration involves the basic information structure of the model. In some cases, shareholders may not learn y because it is prohibitively costly to communicate or motivate. In these cases, contracts fail to unravel agent trading profits because the compensation contract is only contingent upon x. Specifically, a contract that duplicates the allocation obtained when agent trading is prohibited must be designed so that the direct compensation for any x undoes the profits from all y contingent agent trades. The direct compensation, however, can only be designed to unravel the profits from one position. The implication of this observation is that a prohibition on agent trading may have value because compensating managers using uncertain insider trading profits is inherently inefficient.

The second alteration involves incorporating risk averse shareholders. Such an alteration would require significant changes in the model, particularly the shareholders' objective function, that are beyond the scope of this paper. Therefore, only a conjecture that Proposition 2 may no longer hold is offered. This conjecture is motivated by the observation that, when agent trading is permitted, the distribution of the shareholders' return is altered by the increased bid/ask spread even though the bid/ask spread has no impact on the expected return.

III. Alternative Trading Restrictions

Up to this point, only a complete prohibition on agent trading has been considered. Other restrictions on agent trading, such as required registration of trades and prohibition of short sales, were noted in the introduction. The model permits an evaluation of these restrictions.

Consider first the case where agent trades must be registered. Assume the registered trades become public information prior to the payment of compensation to the agent. Since agent trades become public information prior to the payment of compensation, i must be changed in the formal contracting problem to represent the outcome $\{x, y, \omega\}$. It seems obvious that, if trades can be observed prior to paying the agent, the effects of any trades can be undone by specifying a contract which states that direct compensation is decreased by all trading profits and increased by all trading losses. Proposition 3 contains a formal statement of the observation that trade registration allows the shareholders to duplicate the optimal allocation attained when agent trading is prohibited. This result, combined with Proposition 1, establishes that trade registration and trade prohibitions are Pareto equivalent for this model.

Proposition 3: *The allocation attained when the agent must register trades weakly dominates the allocation attained when the agent cannot trade.*

Proof: See the appendix.

In contrast to trade registration, partially restricting the agent's strategy space by prohibiting short selling is generally not as valuable as a complete prohibition. Such restrictions only eliminate some, but not all, agency costs associated with insider trading. Proposition 4 formalizes the observation that short selling restrictions may not allow shareholders to duplicate the optimal allocation derived when agent trading is prohibited.

Proposition 4: *If σ contains multiple action or reporting choices, there exist parameterizations of the model such that the allocation attained when the agent cannot trade strictly dominates the allocation attained when the agent cannot sell short.*

Proof: See the appendix.

To illustrate the result intuitively, consider the case where signal reports cannot be costlessly verified. Any contract that unravels the insider trading profits when the agent truthfully reveals the signal may provide the agent with an alternative optimal strategy: if the agent observes a signal which indicates an increase in the expected return, it may be optimal for him to report a signal that indicates a low expected return and then purchase the security. Therefore, prohibitions on short sales may not completely alleviate the additional agency costs associated with trading by insider agents.

The fact that a prohibition on short sales may not do as well as a complete prohibition on agent trades does not imply that a prohibition on short sales has no value. In the absence of any other prohibitions on agent trading and/or registration of agent trades, a prohibition on short sales by the agent does restrict the strategy space of the agent. The restriction may be sufficient to reduce agency costs and, thereby, increase the expected return to the shareholders.

IV. The Role of Government Institutions and Professional Associations

Although restrictions on agent trading are of value for contracting purposes, they are often implemented and supported by established professional associations or governmental institutions that are not parties to the contract. In this section, the model is extended to show how these external parties may provide a valuable commitment mechanism.

A. The Model

Consider an extension of the model where the risk neutral shareholders are divided into the two groups: initial shareholders and prospective shareholders. At $t = 0$, the initial shareholders privately contract with the agent. The assumption that the contract between the initial shareholders and the agent is private (i.e., not observed by the prospective shareholders or market maker) may be justified by high costs of gathering, transmitting, and processing credible information regarding contracts. At $t = 1$, the initial shareholders sell some portion, $z < 1$, of their shares directly to the prospective shareholders. To keep the model simple, it is assumed that the agent and market maker are not involved in the $t = 1$ sale. After the $t = 1$ sale, the initial shareholders are inactive in the markets for the firm's securities. The prospective shareholders, however, make all of the liquidity trades in the $t = 3$ and $t = 5$ markets.

A crucial feature of the model is that the prospective shareholders do not observe the agent contract. Consequently, the price paid to the initial shareholders for the $t = 1$ purchase is not explicitly contingent on the agent contract. Therefore, an equilibrium must be such that the initial shareholders take the $t = 1$ equilibrium price as given when they design the equilibrium contract at $t = 0$. Furthermore, assuming the prospective shareholders have rational equilibrium beliefs, the $t = 1$ equilibrium price must be a function of the equilibrium contract.

The contracting problem that must be solved by the initial shareholders differs from the earlier decision problem in two respects. First, the initial shareholders are allowed to incorporate a trading prohibition into the agent's contract. Second, the objective function for the initial shareholders differs in that they choose a contract to maximize

$$(1 - z)\sum_{i\in I} \pi_i(a, r, w)(x - c_i) + p_z \tag{9}$$

where p_z is the price received from prospective shareholders for z percent of the firm's shares at $t = 1$. Note that p_z is not contingent on the agent contract. The constraints of the problem are identical to those in the earlier decision problem.

p_z is set by the prospective shareholder's to equal their net expected returns from investments in the firm. The net expected returns are computed assuming rational beliefs about the agent contract. Formally, in equilibrium, p_z equals:

$$\sum_{i \in I} \left[z(x - c_i) + S_3(B_3 - (x - c_i)) + S_6(B_6(y) - (x - c_i)) + P_3((x - c_i) - A_3) + P_6((x - c_i) - A_6(y)) \right] \pi_i(a, r, w) \quad (10)$$

where the optimal contract designed by the initial shareholders implements $\{a, r, w\}$. The specification of p_z just described implies that the prospective shareholders' demand is perfectly elastic and is a function of market liquidity. Furthermore, the perfect elasticity of demand implies that the welfare of the prospective shareholders, like that of the market maker, is not affected by the initial shareholders' contracting decisions.

B. The Value of a Commitment Mechanism

In the extended model just described, a prohibition on insider trading may not be credibly implemented in equilibrium by the initial shareholders even if a prohibition strictly improves their welfare. Therefore, a mechanism that commits the initial shareholders to prohibit agent trading is of value. This result is formally stated in Proposition 5.

Proposition 5: *The initial shareholders weakly prefer a mechanism that commits them to prohibit agent trading. Furthermore, if σ contains multiple action or reporting strategies, there exist parameterizations of the model such that the initial shareholders strictly prefer such a mechanism.*

Proof: See the Appendix.

Proposition 5 is best explained by first discussing why initial shareholders fail to prohibit agent trading in the absence of a commitment mechanism. Since the $t = 1$ price is not contingent on the agent contract and since the initial shareholders make no liquidity trades, the initial shareholders have an incentive to prohibit agent trading only if it increases the expected return they earn on the shares of the firm retained after $t = 1$. A trading prohibition decreases this expected return if the additional expected compensation required to motivate the agent when he may trade is small and/or the agent's valuation of insider trading rights is large.

As stated in Proposition 5, however, a mechanism that commits the initial shareholders to prohibit agent trading always makes them weakly better off and may make them strictly better off. A mathematical reason for this result is apparent if (10) is substituted in for p_z in the initial shareholder's objective function. After the substitution, the initial shareholders' decision problem is identical to the decision problem where all shareholders contract with the agent and Propositions 1 and 2 apply. A more intuitive explanation is as follows. The prospective shareholders and market maker rationally anticipate whether the initial shareholders have an incentive to include a trading prohibition. If trading is not prohibited, the future bid/ask spread faced by the prospective shareholders is increased by the market maker and the $t = 1$ price is lowered to a point where the prospective shareholders are completely compensated for the expected liquidity trading losses attributable to the spread. Consequently, when the initial shareholders do not have an incentive to prohibit agent trading, the increased returns obtained on the shares retained by them after $t = 1$ may be more than offset by the lower $t = 1$ price on the shares sold at $t = 1$.[6]

V. Summary

The main purpose of this paper has been to determine whether a prohibition on insider agent trading has value in a Pareto sense for a particular competitive market structure. Prohibiting agent trading is shown to be of value only if other agency-related problems are present in the contracting environment. The intuitive reasoning behind this result is that when agent trading is allowed, existing agency problems are aggravated. This aggravation arises because, if the agent can trade, his unobservable strategy space expands. Maintaining incentives when the agent has a larger unobservable strategy space forces the shareholders to make costly alterations to agent compensation contracts.

After establishing that complete prohibition of agent trading may be valuable, two related issues are also addressed. First, other restrictions on agent trading are considered to determine whether they are as valuable as complete prohibition. It is argued that trade registration has the same value but that prohibiting short selling is generally of lesser value.

Second, a brief discussion considers the role of government institutions and professional associations in implementing insider trading restrictions. The discussion contains a setting in which an information-constrained market may fail to provide incentives for the implementation of agent trading restrictions even though such restrictions yield a Pareto preferred outcome. This failure arises because the shareholders who contract with the agent are unable to credibly commit to prohibit agent trading. Government institutions and professional organizations provide a mechanism for such commitment.

Appendix

Proof of Proposition 1: Consider any allocation where the agent trades, supported by agent strategy $\{a, r, w\}$, that yields a value of J for the shareholders' objective function. For each state i, let c_i denote the direct state contingent compensation and $e_i(w)$ denote the trading profits. Consider now the case where the agent is completely prohibited from trading. Let c_i' denote the state i agent compensation. Choose the c_i's such that $c_i' = c_i + e_i(w)$ for each i. With this compensation schedule, the agent still has

[6] It should be noted that Proposition 5 holds as long as the initial shareholders do not make all of the liquidity trades.

incentives to choose $\{a, r\}$ and attains expected utility U. Substitution of the bid/ask equilibrium conditions into the shareholders' objective function proves that the shareholders still attain J.

Proof of Proposition 2 (sketch): The *only if* part of the proof is done first by showing that, if the agent's action and report is verified, the optimal allocation attained when agent trading is prohibited can also be attained when the agent trades. When agent action and signal announcement are verified, it is easy to show that the optimal compensation schedule when the agent trading is prohibited is designed so that the agent receives a certain level of compensation (consumption), denoted c, in each state i. Let J denote the value of the shareholders' objective given c.

Consider now a setting where the agent is allowed to trade. The proof is done by postulating a set of security pricing functions and an agent trading strategy for the desired action and truthful reporting strategy. Brouwer's fixed point theorem is used to prove there exists a direct compensation schedule that yields the agent consumption of c in each state given the postulated security pricing functions and agent trading strategy. The postulated pricing functions and agent trading strategy, combined with the derived compensation levels, yield J for the shareholders, satisfy the equilibrium pricing conditions, and satisfy the reservation utility and incentive constraints.

To complete this part of the sketch, the exact form of the security pricing functions, agent trading strategy, and direct compensation levels are presented. The security pricing functions are:

- $A_3 = E(x - c_i) + (u_l/E(P_3))E[\text{Max}\{u_l(E(x - c_i \mid y) - A_3), 0\}]$ (A5)
- $B_3 = E(x - c_i) - (u_s/E(S_3))E[\text{Max}\{u_s(B_3 - E(x - c_i \mid y)), 0\}]$ (A6)
- $A_6(y) = E(x - c_i \mid y)$ (A7)
- $B_6(y) = E(x - c_i \mid y)$ (A8)

where $E(\bullet)$ is the expectations operator. The agent trading strategy, w is:

- if $B_6(y) > A_3$ and $A_6(y) > B_3$ then $p_3(y) = u_l$, $s_3(y) = 0$, $p_6(y) = 0$, $s_6(y) = u_l$
- if $B_3 > A_6(y)$ and $A_3 > B_6(y)$ then $p_3(y) = 0$, $s_3(y) = u_s$, $p_6(y) = u_s$, $s_6(y) = 0$
- otherwise $p_3(y) = 0$, $s_3(y) = 0$, $p_6(y) = 0$, $s_6(y) = 0$.

Under this w, the state conditional profits are:

$$e_i(w) = \text{Max}\{u_l(B_6(y) - A_3), u_s(B_3 - A_6(y)), 0\} \text{ for all } i. \tag{A9}$$

Finally, the direct compensation levels are chosen to satisfy:

$$c_i + \text{Max}\{u_l(B_6(y) - A_3), u_s(B_3 - A_6(y)), 0\} = c \text{ for all } i. \tag{A10}$$

Next, the *if* part of the Proposition is done for the case where there is a revelation problem. In the absence of a moral hazard problem, the optimal compensation contract when agent trading is prohibited provides the agent with a certain level of consumption c. To complete this part of the proof involves showing that, for some form of the model, there does not exist a compensation contract that satisfies the following conditions when the agent is permitted to trade:

- $c_i + e_i(w) = c$ for all i
- $\{\sum_{i\in I} \pi_i(a,\rho,\omega)u(c_i + e_i(\omega)) - f(a)\} - \{\sum_{i\in I} \pi_i(a,r,w)u(c_i + e_i(w)) - f(a)\} \leq 0$ for all $\{\rho, \omega\}$

where w is the optimal trading strategy for the agent when they choose the desired action, reporting strategy $\{a, r\}$ and $e_i(\omega)$ is computed using bid/ask prices based upon agent strategy $\{a, r, w\}$.

Consider the following example with two return states $g > 0$ and $b = 0$, and three signal states h, m, and l. Let $u_l \in [0, 1)$ and $u_s \in [0, 1)$. Finally, assume that

$$\pi_{g\mid h} > \pi_{g\mid m} > \pi_{g\mid l} \text{ which implies } \pi_{b\mid l} > \pi_{b\mid m} > \pi_{b\mid h}$$

where $\pi_{x\mid y}$ denotes the probability of x conditioned on announcement y given the optimal action, reporting strategy, $\{a, r\}$.

Choose any compensation schedule such that, for all i, $c_i + e_i(w) = c$ when the agent selects $\{a, r, w\}$. To support c, c_{gm}, and c_{bm} must satisfy:

$$c = (1 - q)c_{gm} + qg - p_3(m)A_3 + s_3(m)B_3 - p_6(m)A_6(m) + s_6(m)B_6(m) \tag{A11}$$

$$c = (1 - q)c_{bm} - p_3(m)A_3 + s_3(m)B_3 - p_6(m)A_6(m) + s_6(m)B_6(m) \tag{A12}$$

where $q = p_3(m) - s_3(m) + p_6(m) - s_6(m)$. (A11) and (A12) can be combined to yield the following relationship between c_{bm} and c_{gm}:

$$c_{gm} = c_{bm} - \big(gq/(1 - q)\big) \tag{A13}$$

Noting that the equilibrium pricing conditions imply that $A_6(y) = B_6(y) = E(x - c_i \mid y)$, if $\{a, r, w\}$ is the optimal strategy of the agent then there cannot exist a feasible deviation from w of $d \neq 0$ that satisfies equations (A14) and (A15)

$$\sum_{x\in X} \pi_{x\mid h} U\big(c + d\big((x - c_{xm}) - \big(\pi_{g\mid m}(g - c_{gm}) - \pi_{b\mid m}c_{bm}\big)\big)\big) > U(c) \tag{A14}$$

$$\sum_{x\in X} \pi_{x\mid l} U\big(c - d\big((x - c_{xm}) - \big(\pi_{g\mid m}(g - c_{gm}) - \pi_{b\mid m}c_{bm}\big)\big)\big) > U(c) \tag{A15}$$

where $X = \{g, b = 0\}$. If $d \neq 0$ satisfies both (A14) and (A15) then the agent would prefer to report m instead of $h(l)$ when $h(l)$ occurs and purchase (sell) more of the security than specified by w when m is announced. Since either an additional purchase or sale must be feasible (i.e., within the agent's portfolio bounds) the agent may choose the false reporting strategy and preferred deviation away from w in at least one state h or l. Using (A13) to substitute for c_{gm} yields the simplified forms of (A14) and (A15):

$$\pi_{g\mid h}U\big(c + \big(\pi_{b\mid m}dg/(1-q)\big)\big) + \pi_{b\mid h}U\big(c - \big(\pi_{g\mid m}dg/(1-q)\big)\big) > U(c) \tag{A16}$$

$$\pi_{g\mid l}U\big(c - \big(\pi_{b\mid m}dg/(1-q)\big)\big) + \pi_{b\mid l}U\big(c + \big(\pi_{g\mid m}dg/(1-q)\big)\big) > U(c) \tag{A17}$$

By the assumptions on the relative values of the probabilities, some $d \neq 0$ makes both of the gambles represented in (A16) and (A17) have strictly positive expected values that are not a function of the c_is. Furthermore, given some $d \neq 0$, the gamble represented in (A16) ((A17)) has expectation that is increasing in $g(\pi_{g\mid h}\pi_{B\mid m} - \pi_{b\mid h}\pi_{g\mid m})$ $(g(\pi_{b\mid l}\pi_{g\mid m} - \pi_{g\mid l}\pi_{b\mid m}))$. Therefore, for any economy parameterized with sufficiently large $g(\pi_{g\mid h}\pi_{b\mid m} - \pi_{b\mid h}\pi_{g\mid m})$ and $g(\pi_{b\mid l}\pi_{g\mid m} - \pi_{g\mid l}\pi_{b\mid m})$ there exists a $d \neq 0$ that satisfies (A16) and (A17) regardless of the compensation schedule and w that yield the agent c when $\{a, r, w\}$ is chosen.

Finally, the *if* part of the Proposition is completed for the case where there exists a moral hazard problem. Let a and c_i' denote the optimal agent action and state i contingent consumption level when the agent's action cannot be verified and the agent is prohibited from trading. To complete this part of the proof involves showing the existence of an environment such that no compensation contract satisfies the following conditions:

- $c_i + e_i(w) = c_i'$ for all i
- $\{\sum_{i\in I} \pi_i(\alpha,r,\omega)u(c_i' + e_i(\omega)) - f(\alpha)\} - \{\sum_{i\in I} \pi_i(a,r,w)u(c_i' + e_i(w)) - f(a')\}$ ≤ 0 for all $\{\alpha, \omega\}$

where w is the optimal trading strategy of the agent when they choose the action, reporting strategy $\{a, r\}$, and $e_i(\omega)$ is computed using bid/ask prices based upon agent strategy $\{a, r, w\}$.

Consider the following example with two return states, $g > 0$ and $b = 0$, two signal states l and h, and the set of action choices is $\{\alpha_0, \alpha_1, a\}$. Let $u_l \in [0, 1)$ and $u_s \in [0, 1)$. Assume that $f(\bullet) = 0$ for all action choices. This form of $f(\bullet)$ mimics a situation where the agent simply chooses among projects but does not exert any effort on those projects. Finally, assume that

$$\pi_{g\mid h}(\alpha_0) > \pi_{g\mid h}(a) > \pi_{g\mid h}(\alpha_1) \text{ which implies } \pi_{b\mid h}(\alpha_1) > \pi_{b\mid h}(a) > \pi_{b\mid h}(\alpha_0)$$

where $\pi_{x\mid y}(\alpha)$ is the probability of x conditional upon y given the action choice in () and reporting strategy r.

Since $f(\bullet) = 0$ for all action choices, it is easy to show that the optimal contract when agent trading is prohibited is to provide the agent with a certain consumption level. Denote this certain consumption level as c. Let a denote the optimal action.

Consider any compensation schedule such that, for all i, $c_i + e_i(w) = c$ when the agent chooses action, reporting strategy $\{a, r\}$ and optimally chooses trading strategy w. To support consumption level c, c_{gh}, and c_{bh} must satisfy:

$$c = (1 - q)c_{gh} + gq - p_3(h)A_3 + s_3(h)B_3 - p_6(h)A_6(h) + s_6(h)B_6(h) \tag{A18}$$

$$c = (1 - q)c_{bh} - p_3(h)A_3 + s_3(h)B_3 - p_6(h)A_6(h) + s_6(h)B_6(h) \tag{A19}$$

where $q = p_3(h) - s_3(h) + p_6(h) - s_6(h)$. (A18) and (A19) can be combined to yield the following relationship between c_{bh} and c_{gh}:

$$c_{gh} = c_{bh} - gq/(1 - q). \tag{A20}$$

Noting that the equilibrium pricing conditions imply that $A_6(y) = B_6(y) = E(x - c_i \mid y)$, if $\{a, r, w\}$ is the optimal strategy of the agent then there cannot exist a deviation from w or $d \neq 0$ that satisfies equations (A21) and (A22).

$$\sum_{x \in X} \pi_{x|h}(\alpha_1)U\big(c + d\big((x - c_{xh}) - \big(\pi_{g|h}(a)(g - c_{gh}) - \pi_{b|h}(a)c_{bh}\big)\big)\big) > U(c) \tag{A21}$$

$$\sum_{x \in X} \pi_{x|h}(\alpha_0)U\big(c - d\big((x - c_{xh}) - \big(\pi_{g|h}(a)(g - c_{gh}) - \pi_{b|h}(a)c_{bh}\big)\big)\big) > U(c) \tag{A22}$$

where $X = \{g, b = 0\}$. Note that if the agent chooses action α_1 or α_0 and trading strategy w he receives consumption level c in each state i. Therefore, if some $d > 0$ satisfied (A21) ((A22)) then the agent would strictly prefer choosing action α_1 (α_0) instead of action a and purchase (sell) more of the security than specified by w when h is realized and announced. Conversely, if some $d < 0$ satisfied (A21) ((A22)) then the agent would strictly prefer choosing action α_1 (α_0) instead of action a and sell (purchase) more of the security than specified by w when h is realized and announced. Using (A20) to substitute for c_{gh} yields the simplified forms of (A21) and (A22):

$$\pi_{g|h}(\alpha_1)U\big(c + \big(\pi_{b|h}(a)dg/(1 - q)\big)\big) + \pi_{b|h}(\alpha_1)U\big(c - \big(\pi_{g|h}(a)dg/(1 - q)\big)\big) > U(c) \tag{A23}$$

$$\pi_{g|h}(\alpha_0)U\big(c - \big(\pi_{b|h}(a)dg/(1 - q)\big)\big) + \pi_{b|h}(\alpha_0)U\big(c + \big(\pi_{g|h}(a)dg/(1 - q)\big)\big) > U(c) \tag{A24}$$

By the assumptions on the relative values of the probabilities, some $d \neq 0$ makes both of the gambles represented in (A23) and (A23) have strictly positive expected values independent of the c_is. Furthermore, the gamble represented in (A23) ((A24)) has an expectation increasing in $g(\pi_{g|h}(\alpha_1)\pi_{b|h}(a) - \pi_{b|h}(\alpha_1)\pi_{g|h}(a))$ $(g(\pi_{b|h}(\alpha_0)\pi_{g|h}(a) - \pi_{g|h}(\alpha_0)\pi_{b|h}(a)))$. Therefore, for any economy parameterized with sufficiently large $g(\pi_{g|h}(\alpha_1)\pi_{b|h}(a) - \pi_{b|h}(\alpha_1)\pi_{g|h}(a))$ and $g(\pi_{b|h}(\alpha_0)\pi_{g|h}(a) - \pi_{g|h}(\alpha_0)\pi_{b|h}(a))$ there exists a $d \neq 0$ that satisfies (A21) and (A22) regardless of the compensation schedule and w that yield the agent c when $\{a, r, w\}$ is chosen.

Proof of Proposition 3: Consider any optimal contract when agent trading is prohibited. Denote the contingent compensation levels under this contract as c_is. Now consider an environment where the agent may trade and where agent trades are registered. Design a new compensation schedule such that, for any state, i, and registered trading strategy, ω, the compensation is $c_i\omega = c_i - e_i(\omega)$. Under this new compensation schedule, the agent is indifferent between all trading strategies so any trading strategy may be costlessly supported. Therefore, agent trading is costless if agent trades are registered.

Proof of Proposition 4: The proof for the case when agent announcements cannot be verified uses the specific example in the proof to Proposition 2 with the additional assumptions requiring $u_s = 0$ and $u_l < 1$. The proof for the case when agent actions cannot be verified uses the example in the proof to Proposition 2 with the additional assumptions requiring $u_s = 0$ and $u_l < 1$.

Proof of Proposition 5 (sketch): The proof proceeds in two steps. First, the initial shareholders are shown to be weakly, and possibly strictly, better off if agent trading prohibited. Second, a case is provided where, in the presence of a revelation problem, the prohibition makes the initial shareholders strictly better off and it fails to be implemented in the absence of a commitment mechanism. An analogous case may be derived when there is a moral hazard problem.

After substituting the equilibrium pricing condition, (10), in for p_z in the initial shareholder's objective function, it is easy to see that the resulting decision problem is identical to the decision problem when all shareholders contract with the agent. Propositions 1 and 2 are employed to show that the initial shareholders are weakly, and possibly strictly, better off when agent trading is prohibited.

A simple example is used to demonstrate that, if there is a revelation problem and no commitment mechanism, there may not exist an equilibrium where the initial shareholders prohibit agent trading even if the prohibition makes them strictly better off. There is a single action, a, two return states, $g = 726$ and $b = 6$, and three signals, h, m, and l. The signal reported is not verified by the shareholders. The probability structure is such that $\pi_g = \pi_b = {}^1/_2$, $\pi_h = \pi_m = \pi_l = {}^1/_3$, $\pi_{g|h} = \pi_{b|l} = 1$, $\pi_{g|l} = \pi_{b|h} = 0$, $\pi_{g|m} = {}^1/_2$, $\pi_{b|m} = {}^1/_2$. The agent's utility function is $c^{1/2} - a$ if $c \geq 0$ and $-\infty$ if $c < 0$. The reservation utility level is 1. If the agent is not prohibited from trading, the bounds on agent trading positions are $u_s = u_l = 0.1$. Finally, the initial shareholders are assumed to want to sell 50% of the firm to the prospective shareholders. With this particular parameterization, if agent trading is prohibited, the initial shareholders are strictly better off (substitute (10) in for p_z in the initial shareholders' objective function and see the revelation problem example in the proof to Proposition 2).

It is possible to show by contradiction that there does not exist an equilibrium where the initial shareholders prohibit agent trading. Select any conjectured equilibrium where the initial shareholders prohibit agent trading. If such an equilibrium exists, the direct compensation must be 4 in all states or else the contract is not optimal for the initial shareholders. Furthermore, the bid and ask prices must satisfy $B_3 = A_3 = B_5(m) = A_5(m) = 362$, $B_5(h) = A_5(h) = 722$, $B_5(l) = A_5(l) = 2$. Finally, the value of p_z must be 181, and the value of the initial shareholders' objective must be 362.

The optimal compensation and associated prices, however, result in the conjectured equilibrium failing to be an equilibrium. With these security prices, the initial shareholders have an incentive to eliminate the trading restriction on the agent. Specifically, consider the following deviation from the conjectured contracting strategy for the initial shareholders. Let the agent trade in securities and let the direct compensation of the agent contingent on the signal report and return realization be: -150 for $\{l, g\}$ and $\{h, b\}$; 0 for $\{h, g\}$, $\{l, b\}$, $\{m, g\}$ and $\{l, b\}$. With the proposed compensation schedule and the conjectured equilibrium security prices, the incentive and reservation utility constraints are both satisfied. Furthermore, with $p_z = 181$, the value of the initial shareholders' objective function is 364. Therefore, there does not exist an equilibrium where the initial shareholders prohibit agent trading.

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