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Best Execution in Securities Markets: An Application of Signaling and Agency Theory

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I. Introduction

A SECURITIES BROKER executing a customer's purchase or sale order acts as an agent for that customer, and thereby assumes certain duties in the eyes of the law. The Restatement of Agency 2d (1958) observes that a broker has a duty "to obtain terms which best satisfy the manifested purposes" of his customer (§424), and that he must "act solely for the benefit of [his customer] in all matters connected with his agency" (§387). The Securities and Exchange Commission (SEC) has more specifically observed that a broker who accepts a customer's sell order has "a fiduciary duty . . . to sell the stock at the highest possible price."[1]

The legal characterizations of a broker's duty to obtain "best execution" of a customer's order seem reasonable at first glance. However, they ignore the economic characteristics of an agency relationship. In particular, a principal knows that an agent has an incentive to act in his own self-interest, and he will try to set his agent's fee schedule to induce what he views as favorable behavior by the agent [see Ross (1973), Shavell (1979), Holmstrom (1979), Baron (1979), and Baron and Holmstrom (1980)]. More importantly, the SEC position fails to recognize that search for better purchase or sale opportunities is not free, but consumes real resources [see Stigler (1961), McCall (1965, 1970), Nelson (1970) and Garbade and Silber (1976)]. The SEC position can, if taken literally, result in inefficient order execution in markets with imperfect information flows and costly search.

This paper addresses the problems of defining and obtaining "best" execution of an agency order for the purchase or sale of securities. Section II develops the definition of best in the sense of efficiency. Section III describes why a customer has an incentive to use a broker as an agent to complete his order, and section IV analyzes the conflicts of interest that arise between brokers and customers.[2] Section V discusses the institutional arrangements that have emerged in securities markets to elicit favorable agency executions. Three arrangements are described: (1) explicit contracting to limit an agent's discretion; (2) signaling by agents to validate claims of superior execution; and (3) collective action to mitigate the

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[1] Securities and Exchange Commission, "Investment Service Co.," Release 34-6884 (August 15, 1962). See also the "best execution" rule of the NASD: National Association of Securities Dealers Rules of Fair Practice, Article III, Section 1, Interpretation .03.

[2] We analyze only those conflicts that arise *after* a customer has decided to buy or sell securities. We do not examine the conflicts inherent in broker recommendations to buy or sell. See Wolfson, Phillips, and Russo (1977, pp. 2-23—2-38) and Mayer (1980).

conflicts of interest between customers and brokers and to reduce the costs of monitoring and limiting broker performance.

Defining and obtaining best execution of agency orders are crucial issues when search is costly and when buyers and sellers are not centralized. Thus, best execution has long been associated with over-the-counter (OTC) trading in municipal, corporate, and Treasury bonds and unlisted stocks. More recently, these issues have become important for New York Stock Exchange (NYSE) listed stocks in light of the SEC's decision to end restrictions on OTC trading of listed stocks by NYSE member firms.[3] Trading in identical futures contracts or option contracts on more than one exchange also raises problems of best execution.[4] Thus, the issues we address are relevant for transactions in a broad spectrum of financial instruments.

II. Defining Best Execution by an Agent

It seems reasonable to define best execution of an agency order in terms of how a rational agent would trade his own securities. For purposes of analysis we treat the case where an agent is selling securities.[5]

In a market where buyers quote different bid prices [see Garbade and Silber (1976)], an agent seeking to sell his own securities will search among different buyers as long as the expected gain exceeds the cost of obtaining another bid. Suppose, for example, an agent is selling N securities. The expected gain, $\theta(P_0)$, from obtaining another bid P, given that P_0 is the best bid uncovered to date, is the expected value of the gross sale proceeds available after obtaining the new bid (i.e., the expected value of $N \cdot \max[P, P_0]$), less the gross sale proceeds presently available (i.e., $N \cdot P_0$). If bid quotations are distributed over the interval $[P_{\min}, P_{\max}]$ according to the probability density function $f(\cdot)$,[6] then:

$$\theta(P_0) = N \int_{P_{\min}}^{P_{\max}} \max[P, P_0] \cdot f(P) \cdot dP - N \cdot P_0$$

$$= N \int_{P_0}^{P_{\max}} (P - P_0) \cdot f(P) \cdot dP \tag{1}$$

If $\theta(P_0)$ exceeds the cost, C_a, of another contact, then it is efficient to obtain another bid, and conversely if $\theta(P_0)$ is less than C_a. Note that $\theta(P_0)$ is a decreasing function of P_0, so that the expected gain from further search is smaller the larger the value of the best bid uncovered to date.

An agent can be viewed as establishing a "reservation sale price," denoted P_r^a,

[3] See Securities and Exchange Commission, "Off-Board Trading Restrictions," Release 34-13662 (June 23, 1977); and "Off-Board Trading Restrictions," Release 34-16888 (June 11, 1980).

[4] See Silber (1981) and Securities and Exchange Commission, "Market Structure Issues Concerning Standardized Options Trading," Release 34-14854 (June 15, 1978).

[5] For expositional simplicity we ignore risk in securities transactions, and focus on the expected net sale price. In particular, we ignore risk sharing in agency relationships. See Ross (1973), Mandelker and Raviv (1977), Baron and Holmstrom (1980) for analyses of risk sharing.

[6] For simplicity, we assume brokers know the true distribution of bids.

which equates the marginal cost of additional search with the expected marginal gain of that search. An agent searches efficiently if he rejects all bids less than the reservation sale price, and if he accepts the first bid equal to or greater than the reservation price. The reservation price is the solution, P_r^a, to the equation $C_a = \theta(P_r^a)$, or, from equation (1), the solution to:

$$C_a = N \int_{P_r^a}^{P_{\max}} (P - P_r^a) \cdot f(P) \cdot dP \tag{2}$$

Further search is inefficient after a bid price better than the reservation price has been uncovered, because $\theta(P_0)$ is a decreasing function of P_0 and, therefore, $\theta(P_0) < C_a$ for $P_r^a < P_0$.

Equation (2) implies that the reservation sale price is lower if C_a is larger and is higher if N is larger.[7] The first point indicates that higher search costs imply less extensive search efforts. The second point suggests that it is efficient to search more extensively to find a buyer for a larger sale order. Thus, different size orders should not necessarily be handled in the same way.

Equation (2) also implies that unless search is free, it is inefficient to search until the "best" bid has been uncovered. More specifically, $P_r^a < P_{\max}$ if $C_a > 0$. Thus, the SEC's simple characterization of best execution as a sale at the highest price is proper only where search is a free good.

III. Advantages of Efficient Agency Execution

An appendix to this paper shows there are two circumstances where the expected net proceeds from efficient agent search exceed the expected net proceeds from efficient principal search. The first is when the principal's cost of obtaining a bid quotation exceeds the agent's cost of contact. This is likely, because a broker who handles many customer orders has an incentive to employ search devices with low marginal costs. Some examples include printed lists of quotations like the "Pink sheets" and the Blue List [see Garbade (1982, pp. 439–440 and 462–463)], and electronic devices like NASDAQ and the Kenny wire [see Garbade (1982, pp. 440–442 and 463–465)]. The second circumstance is when the principal's reservation sale price differs from the agent's reservation price. This will occur if there is a difference in contact costs or in knowledge about the distribution of quotations. The latter condition is likely, because a customer is not usually involved in the market on a continuous basis. Thus, under reasonable assumptions, principals have an incentive to use agents to execute their securities transactions if those agents execute the transactions efficiently.

IV. Conflicts of Interest in Agency Relationships

The analysis in the previous section pointed out the advantage to a customer of an efficient sale of securities by a broker, but it did not consider how the broker

[7] If C_a increases, the left-hand-side of (2) will increase. The only way to increase the righthand-side is to decrease P_r^a. If N increases, the lefthand-side of (2) remains the same but the righthand-side initially increases. The only way to push back down the righthand-side is to increase P_r^a.

gets paid for his efforts. The broker's compensation schedule is important, because it may create an incentive for the broker to execute a transaction inefficiently. More particularly, a broker may not find it in his own interest to set a reservation sale price which satisfies equation (2), and to search until he finds a bid in excess of that price. This section describes two simple compensation schemes, and points out the conflicts of interest between principal and agent created by each.

The compensation scheme implicitly assumed in Section III is that a customer pays his broker for his search efforts at the rate C_a per contact, and receives the gross proceeds realized on the sale of his securities. Since his search costs are fully reimbursed, the broker has no incentive to set an inefficient reservation price and do more or less than the optimal amount of search. However, he does have an incentive to represent to his customer a lower sale price than he actually obtained,[8] and to *claim* that he made more contacts than was the case. Both of these possibilities suggest that principals should spend resources verifying the claims of their agents. The costs of these verification efforts reduce the advantages of agency execution. [The effect of surveillance costs on an agency relationship is also considered by Jensen and Meckling (1976).]

As a practical matter, verification of a sale price is probably much easier than verification of an agent's search efforts. Most exchange markets, for example, provide ticker tape records of transaction prices, and require that trade tickets be time-stamped. These practices facilitate *ex-post* verification of sale prices.[9]

A second compensation scheme, which eliminates the need to verify an agent's search efforts, is for the customer to pay his broker's *ex-ante* expected cost of search. In fact, we typically observe just such predetermined or "fixed" commission charges in the brokerage industry. Note that this *ex-ante* approach suggests why brokerage commissions vary with the size of an order. In particular, it is necessary to compensate a broker for the additional contacts that are expected in executing efficiently a larger order.

Setting fixed commission rates eliminates the search effort deception problem for the principal, but leaves the agent with an incentive to do less than an optimal amount of search, because he derives no additional compensation for making more contacts. In fact, it may be in the broker's self-interest to set $P_r^a = P_{\min}$ and to sell to the first bid which he uncovers.[10] (Exceptions to this statement are discussed below.) Moreover, customers will be unwilling to pay commissions

[8] Misrepresentation of a transaction price may seem farfetched, but see Hoffman (1932, pp. 345–346) for examples of misrepresentations involving market orders and stop orders. See *Business Week*, November 9, 1981, p. 116, col. 3 for a more contemporary example.

[9] In 1977 the Commodity Futures Trading Commission (CFTC) required all commodity exchanges to record the time of execution of every trade to the nearest minute for the specific purpose of detecting abuse of customers by brokers [see CFTC Release 201-76 (September 21, 1976) and Release 233-76 (December 23, 1976)] The CFTC subsequently relaxed its regulation to require only a record of the 30 minute time bracket in which a trade was executed [see CFTC Release 671-80 (December 4, 1980)]. See *Wall Street Journal*, October 17, 1977, p. 40, col. 1, for industry criticism of the original CFTC initiative. We discuss the provision of transaction prices to verify agency eecution in Section I below.

[10] We do not consider the extent to which actions for damages (based on the legally enforceable rights of a principal which are associated with the duties of an agent noted in Section 1) create incentives for an efficient execution as defined in Section 2.

based on brokers' claims that they will make more than one contact, if customers anticipate that brokers will renege. Thus, the equilibrium level of commissions will compensate brokers for making only a single contact.[11]

When search among more than one bidder is advantageous, economic arrangements more complex than fixed brokerage commissions are likely to emerge to induce more efficient agency behavior. The next section considers several possibilities. Before turning to that discussion, however, it is useful to consider the implications of the case where a broker makes only a single contact before selling a customer's securities.

In general, it will be in a customer's self-interest to agree to a fixed commission and to have his broker make only a single contact if the expected net proceeds from the resulting sale exceed what the customer could get from his own efforts or from some more complex arrangement. For example, if a broker is indifferent about contacting any of several competing sources of bids, he might announce that he will go to that source which on average has had the best bid. (This claim does not need validation, because the broker does not have any interest in acting to the contrary.) If the difference between the search costs of the customer and the broker are large, or if there is a high probability that the best bid on average will be above the efficient reservation price, the customer will be better off using the broker's single-contact service rather than searching himself.

The scenario described above helps explain broker representations that they send customer orders to "the most liquid market," given a choice of several exchanges where identical orders in stock, or options, or futures can be executed. For example, most brokers route customer orders in Treasury bond futures to the Chicago Board of Trade rather than to the less liquid New York Futures Exchange. A more liquid market has smaller spreads between bid and offer prices, and hence is more likely to have higher bids and lower offers relative to a less liquid market. Failure to attract agency order flow has been a major factor in the limited success to date of the New York Futures Exchange. In general, the liquidity of an established market makes it difficult for a new competitor to succeed [see Silber (1981)].

There are two important cases where a broker will not be indifferent about where he directs a customer order, leading to conflicts of interest even in the single-contact service. First, he may not wish to execute on an exchange of which he is not a member, because of the added costs of subcontracting an order. Customers may, therefore, refrain from dealing with brokers who are members only of relatively illiquid exchanges, when trading securities listed on more liquid exchanges. In this context, we note that regional stock exchanges have had to guarantee that dealing through their member-brokers will be as advantageous as dealing through member-brokers of the New York Stock Exchange in order to attract orders which would otherwise have gone to the NYSE.[12]

[11] This result parallels Klein and Leffler (1981) on the absence of goods better than minimum quality in a marketplace.

[12] See *In the Matter of Applications by the Boston Stock Exchange for Unlisted Trading Privileges*, 2 S.E.C. 513 (1937) and 3 S.E.C. 693 (1938); Securities and Exchange Commission (1963, pp. 911–952); and Securities and Exchange Commission, "Off-Board Trading Restrictions," Release 34-16888 (June 11, 1980) ftnts 19 and 45. The validity of the guarantee of NYSE prices by regional exchanges is a separate issue. We discuss whether such a guarantee is credible in Section 5.

A broker may also have a preference among alternative sources of bids (and hence offer suspect services) if he himself is a bidder, i.e., if the broker also acts as a dealer or marketmaker. In the context of permitting off-board marketmaking in NYSE-listed issues by NYSE members, the SEC expressed concern that the resulting combination of agent and principal functions would expose retail customers to "overreaching," that is, a broker-dealer acting as principal and executing at poorer net prices than if that broker-dealer had acted as agent. The Commission initially proposed a variety of regulatory devices to limit overreaching, including: segregation of the broker and dealer functions; mandatory execution of a customer agency order at the best available price if that order was executed on a principal basis; and disclosure of the best price available at the time an agency order was executed on a principal basis.[13] In the end, however, the SEC left the problem to market forces. At this time the volume of off-board retail trading by NYSE members has not grown sufficiently to observe the market's response to potential overreaching by broker-dealers.

V. Inducing Efficient Agency Execution

The previous section demonstrated that a single-contact service will be the only viable brokerage service when principals give their agents unlimited discretion and compensate them with a fixed commission. However, when there are significant economic incentives to have agents search more intensively, we can expect market responses which induce more than single-contact brokerage services. In particular, we should observe brokers offering more extensive search services that can be verified by principals. This section examines three mechanisms for inducing efficient agency execution of a customer sale order, including: (1) explicit contracting; (2) signaling; and (3) collective action.

Explicit Contracting. One source of the broker-customer conflict of interest described in Section IV is that the broker performs two functions: selling information by determining a reservation sale price; and selling the search service of contacting buyers until a bid exceeding the reservation price is uncovered. [See Darby and Karni (1973) for other examples of joint sales of information and goods or services.] A simple contracting device to eliminate the conflict is to separate these two functions. This can be done with an order that removes the broker's discretion in setting the reservation price. For example, when the customer specifies a limit order, he sets his own reservation sale price and asks the broker to search until he uncovers a bid at least as good as that price.[14]

To use a limit order effectively, a customer must identify a limit price close to the efficient reservation sale price. There are two ways this can be done. First, the customer might purchase the information from another broker. Since that broker will not search for the customer, he has no incentive to misrepresent the efficient reservation price.[15] Second, the customer might produce the information

[13] Securities and Exchange Commission, "Off-Board Trading Restrictions," Release 34-13662 (June 23, 1977).

[14] See Morrison and Pierce (1981) and Hoffman (1932, pp. 177 and 180) for discussions of the advantages of limit orders and other orders more complex than simple market orders.

[15] J. J. Kenny Co., a broker in municipal bonds, offers such an information service. [See Garbade (1982, pp. 463–465)]. Kenny collects a sample of bids on a particular offering of bonds. On the basis of that sample, the customer can decide whether to sell to the highest available bid or whether to continue to search.

himself by acquiring knowledge of the distribution of bid prices.[16] Since the customer is unlikely to be as well-informed as a broker about the price distribution, and since he may not know his broker's cost of contact, the customer probably would specify a limit price different from the efficient reservation price. Nevertheless, this separation of services solution to the principal's problem may be better than letting the broker both set the reservation sale price and conduct the search.

We have seen that when a customer limits his broker's discretion by specifying his own reservation price on a limit sale order, he must acquire more information on the distribution of prices. It follows that limit orders will become more attractive, the cheaper the cost of acquiring such information. We will return to this point below in our discussion of collective action.

Signaling. Thus far we have examined agency executions of customer orders as if each transaction were an isolated event in the life of both the principal and the agent. However, most broker-customer relationships are ongoing rather than discrete events, and there are devices other than explicit contracting that facilitate efficient execution of repetitive agency orders.[17] In particular, agents may spend resources to validate their claims of superior execution. A specific example is instructive.

Suppose a broker claims that he sets reservation sale prices on customer orders above the minimum available bid and/or that he makes more than one contact in looking for a favorable bid. As described in Section IV, such claims are not credible if the agency relationship is a discrete event. However, if a broker jeopardizes future customer business by reneging, customers may place some faith in his claims. More particularly, Klein and Leffler (1981) have pointed out that non-salvageable assets (such as goodwill and advertising) provide signals that validate representations of superior quality as long as an ongoing customer relationship exists. Thus, we find brokers advertising superior execution services, and these claims are not dismissed by potential customers.[18]

A second component to evaluating a claim of superior agency execution is for the customer to be capable of verifying *ex post* performance.[19] In general, modest claims, such as, "we always check at least three markets," may be relatively easy to verify over the course of repeated sales through a broker. In such cases, a

[16] In 1980 the SEC mandated that Level 1 NASDAQ terminals display the best available bid and offer quotations, rather than representative bids and offers, in order to provide customers with more informative price information. See Securities and Exchange Commission, "Dissemination and Display of Transaction Reports and Quotation Information," Release 34-15251 (October 20, 1978); and "Dissemination and Display of Transaction Reports, Last Sale Data, and Quotation Information," Release 34-16590 (February 19, 1980).

[17] See Macaulay (1963) for other examples where transactors rely on informal, implicit, contracting and reputation (in the context of ongoing relationships) rather than on explicit contracting to structure the terms of a transaction.

[18] Similarly, regional stock exchanges and exchange specialists use goodwill and reputation to signal the validity of their guarantee of NYSE prices. See footnote 12 above.

[19] In 1977 the SEC proposed that broker confirmations on transactions in securities listed on NASDAQ disclose the best contemporaneous bid and offer prices in order to give customers information needed to assess the quality of service provided by their brokers. Securities and Exchange Commission, "Securities Conformations," Release 34-13661 (June 23, 1977). The Commission subsequently declined to adopt the proposed rule in view of the costs of such disclosure. Securities and Exchange Commission, "Securities Conformations," Release 34-15219 (October 6, 1978).

small amount of information may permit a customer to conclude that the broker was not selling to the first uncovered bid. It would be much more difficult to verify a more complicated claim. For example, checking that a broker always sold to bids greater than or equal to efficient reservation sale prices would require substantial information.

Verifying broker claims of superior agency execution requires some knowledge of the distribution of available bid prices. It follows that broker signals of superior execution will better facilitate efficient agency execution the cheaper the cost to customers of acquring information on quotations. With this in mind, we now turn to the institutional arrangements which enhance customer knowledge.

Collective Action. Customers have two reasons for wanting more information on bid quotations: first, to set more efficient reservation sale prices on their limit orders; and second, to monitor broker claims more effectively. The question is, what induces the collection and publication of such information?

Three forces prompt securities brokers and others to act collectively to gather and make available information on quotation and transaction prices. First, each broker knows that his claim of superior execution is more believable, the more easily customers can verify such claims. Second, more accurate and timely price information might stimulate interest in securities trading by customers. Third, better and more timely price information reduces the costs of search incurred by brokers and dealers themselves.

Each of these forces helps to explain price disclosure by the securities industry. In fact, the last factor played a key role in the innovation of the National Association of Securities Dealers Automated Quotation System (NASDAQ) in 1971. That system shows a montage of dealer bid and offer prices [see Garbade (1982, pp. 440–442)], and is available to institutional investors as well as to brokers and dealers. Both dealers and institutional investors had substantial incentives to innovate a device which disclosed quotation prices more cheaply than the former system of telephone search.

When price data are available on a timely basis, the first two factors mentioned above prompt the public dissemination of those prices by trade associations of brokerage firms. Disclosure by a trade association insures that no individual broker can distort published prices. Thus, we find that transactions prices (high, low, and close) on the major securities exchanges are made available daily to newspapers. This information allows a customer to determine, over time, whether his broker consistently executes unfavorable sales, e.g., sales at or near the low price of the day.

It should be noted that arrangements like NASDAQ, which enhance the dissemination of price information, also reduce the conflicts of interest between customers and their agents. In the limit, if an agent's search costs vanish, so that $C_a = 0$, an agent has no incentive to set a reservation sale price different from the efficient reservation price, which would then be the maximum available bid (see equation (2)). Search by an agent becomes a free good, and customers can expect their brokers to search efficiently. Thus, information devices which reduce search costs also reduce the need for signals and explicit contracts in promoting efficient agency execution.

Search costs can also be reduced by collective action to restructure the

organization of a market. For example, a periodic call auction consolidates purchase and sale orders at a particular point in time and generates a single transaction price at which all buyers and sellers trade [see Garbade and Silber (1979)]. Unlike a dealer market with continuous trading at quoted bids and offers, a periodic call auction requires no search by an agent. Thus $C_a = 0$ in a periodic call auction, thereby guaranteeing transactions at best prices. The best example of a periodic call auction is the London gold fixings market [see Garbade (1982, pp. 201–203)].

VI. Some Comparisons

The main conclusion that emerges from this overview is that best execution in securities markets is accomplished through a variety of contracting, signaling, and collective action arrangements. Each approach facilitates the provision of more efficient transaction prices by an agent for a principal. It is interesting to note, however, that the effectiveness of both contracting and signalling in promoting efficient execution is enhanced by the collective dissemination of price information. But the collective decision to disclose price information also serves to reduce broker-customer conflicts, and hence reduces the need for explicit contracting and signaling. Thus, public disclosure of transactions-related data is both a substitute and a complementary factor in the production of efficient agency executions of securities transactions.

Appendix

This appendix demonstrates the superiority of efficient agency execution of sale orders relative to efficient principal execution. To show this result we compare the expected net proceeds from the two types of sales.

The expected net proceeds from a sale of securities is the expected sale price times the number of securities sold, less the expected number of contacts times the cost per contact. Thus, we first need to derive the probability density functions of the realized sale price and the realized number of contacts. Suppose bid quotations are distributed over the interval $[P_{\min}, P_{\max}]$ according to the probability density function $f(\cdot)$ and that the reservation sale price is P_r. Define $S(P_r)$ as the probability of obtaining a price equal to or better than the reservation price P_r on any given contact:

$$S(P_r) = \int_{P_r}^{P_{\max}} f(P) \cdot dP \tag{A1}$$

The probability density function of the realized sale price, given that a sale will not be made at any price less than P_r, is:

$$g(P) = \begin{cases} f(P)/S(P_r) & P \in [P_r, P_{\max}] \\ 0 & \text{otherwise} \end{cases} \tag{A2}$$

The probability density function of the number of contacts required to find a

price equal to or better than P_r is:

$$h(n) = [1 - S(P_r)]^{n-1} \cdot S(P_r) \qquad n = 1, 2, \cdots \tag{A3}$$

If the cost per contact is C, the expected net proceeds from a sale of N securities is:

$$\begin{aligned} ENP(P_r, C) &= N \int_{P_r}^{P_{\max}} P \cdot g(P) \cdot dP - C \sum_{n=1}^{\infty} n \cdot h(n) \\ &= N \overset{\circ}{+} S^{-1}(P_r) \int_{P_r}^{P_{\max}} P \cdot f(P) \cdot dP \\ &\quad - C \sum_{n=1}^{\infty} n \cdot [1 - S(P_r)]^{n-1} \cdot S(P_r) \\ &= \left\{ N \int_{P_r}^{P_{\max}} P \cdot f(P) \cdot dP - C \right\} / S(P_r) \end{aligned} \tag{A4}$$

Because of the optimality of the agent's reservation sale price P_r^a as defined in equation (2), we have:

$$ENP(P_r, C_a) < ENP(P_r^a, C_a) \quad \text{when} \quad P_r \neq P_r^a \tag{A5}$$

where C_a is the agent's cost per contact.

Now suppose a principal incurs a cost per contact of $C_p \geq C_a$ and, on the basis of C_p and his view of the distribution of bid prices, has a reservation sale price of P_r^p which may differ from P_r^a. Since we have assumed that the agent's view of the distribution of prices is correct, the difference in expected net proceeds is:

$$\begin{aligned} &ENP(P_r^a, C_a) - ENP(P_r^p, C_p) \\ &= \left\{ N \int_{P_r^a}^{P_{\max}} P \cdot f(P) \cdot dP - C_a \right\} / S(P_r^a) \\ &\quad - \left\{ N \int_{P_r^p}^{P_{\max}} P \cdot f(P) \cdot dP - C_p \right\} / S(P_r^p) \\ &= \left\{ N \int_{P_r^a}^{P_{\max}} P \cdot f(P) \cdot dP - C_a \right\} / S(P_r^a) \\ &\quad - \left\{ N \int_{P_r^p}^{P_{\max}} P \cdot f(P) \cdot dP - C_a \right\} / S(P_r^p) + (C_p - C_a) / S(P_r^p) \\ &= ENP(P_r^a, C_a) - ENP(P_r^p, C_a) + (C_p - C_a) / S(P_r^p) \end{aligned} \tag{A6}$$

From (A5) the difference between the first two terms in (A6) is non-negative and

will be zero only if $P_r^a = P_r^p$. The last term is also non-negative and will be zero only if $C_p = C_a$. Thus, a principal has an incentive to use an agent who searches efficiently if: (1) $C_p > C_a$; or (2) $P_r^p \neq P_r^a$. The latter condition can occur either because of a difference in contact costs or because of a difference in knowledge about the distribution of bid quotations. If the principal knows as much as the agent about the distribution of bids, but $C_p > C_a$, then $P_r^p < P_r^a$, i.e., the principal will not search as intensively as the agent because of his higher costs of search. If $C_a = C_p$ but the principal believes that bids have a more diffuse distribution than $f(\cdot)$, then $P_r^p > P_r^a$, i.e., the principal will search more intensively than the agent because he believes there are better bids to be found than is the case. Note that higher principal search costs and poorer principal information have opposite effects on the relation between P_r^a and P_r^p.

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