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Packaging Liquidity: Blind Auctions and Liquidity Provision

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Packaging Liquidity:
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We investigate a liquidity provision mechanism whereby liquidity demanders auction a set of trades as a package directly to potential liquidity providers. A critical feature of the auction is that the identities of the securities in the package are not revealed to the bidder. We demonstrate that this mechanism provides a transactions cost savings relative to more traditional trading mechanisms for the liquidity demander as well as an efficient way for liquidity suppliers to obtain order flow. We argue that the cost savings afforded this new mechanism is due to the potential for low-cost crosses with the bidder's existing inventory positions and through the longer trading horizon, and superior trading ability, of the bidders. This research suggests that the ability to innovate via new liquidity provision mechanisms can provide market participants with transaction cost savings that cannot be easily duplicated on more traditional exchanges.

Financial markets have evolved with the implicit goal of minimizing search costs and maximizing the level of liquidity available, thereby increasing transactions efficiency for market participants. As markets have developed, market participants have revealed a desire to use trading venues that display a wide and varied set of execution characteristics. For example, consider how the 'upstairs market' has developed in order to allow market participants the ability to trade large blocks of stock in a single trade. Another attribute valued by market participants is the ability to trade a set of assets as a single unit, which has led to the development of the 'basket trading' market. More recently, electronic communication networks (ECNs), valued for their speed of execution, have provided market participants with the ability to pursue high frequency trading strategies.

Despite the revealed preferences of market participants, many academics, regulators and practitioners question the benefits of having order flow fragmented among competing trading venues.[1] Market fragmentation opponents argue that consolidation of competing trading venues enhances liquidity provision and therefore improves 'best execution' for all market participants. With this fragmentation-consolidation debate as a backdrop, two important unanswered questions are: (1) Can alternative liquidity provision mechanisms be designed that provide transaction efficiencies relative to traditional liquidity provision mechanisms? and (2) How will the cost savings produced by this increased efficiency be generated and allocated among the parties to the transaction?

We analyze a relatively new trading mechanism, a "blind" auction of a package of transactions, to demonstrate that innovations in liquidity provision can benefit market participants with transaction efficiencies that are not easily duplicated on more traditional exchanges. In this blind auction a liquidity demander (asset manager) auctions a portfolio of trades directly to a set of liquidity providers (brokers). A key feature of this mechanism is that many trades are pooled together into a portfolio, or package. A unique feature of the auction is that the bidders have only aggregated information concerning the individual trades in the package. That is, the identities of the individual securities in the package are not revealed to the

[1] See for example, Levitt (1999) and Pirrong (1999).

bidders.[2] The liquidity demander has the option to accept the lowest bid or reject all bids. Available evidence suggests that this mechanism is well established in the trading community and growing quickly. There are approximately 40 asset managers who regularly solicit bids on packages with 6 brokers actively bidding (see Chapman (2000)).

We examine the transactions associated with 83 packages of equity trades with a combined value of $7.32 billion that were auctioned by an asset manager (the liquidity demander) over the period July 1998 to August 2000. Our results suggest that trading the packages via the blind auction mechanism resulted in trading costs that were 81 basis points lower than a benchmark estimate of trade costs that accounts for the difficulty of executing the individual trades (e.g., the size of the individual trades, the liquidity of the market for the stock, and the exchange on which the stock trades). This amounts to a 46 percent reduction in transaction costs relative to trading via traditional trading venues. At the same time, liquidity suppliers (bidders) are able to obtain order flow cheaply. The results suggest that the liquidity demander's cost savings from this liquidity provision mechanism hinge upon the liquidity providers (bidders) possessing both inventory positions with which they can cross many of the trades within the package and a longer trading horizon. To a lesser extent our results are also consistent with the cost savings being generated from liquidity providers' (bidders) superior trading ability.

The remainder of the paper is organized as follows. Section I provides the motivation for the study, describing the advantages of packaging and auctioning securities as well as the details of a typical package auction and the supporting data used in the study. Section II compares the costs of trading a package with estimates of the benchmark cost of trading the securities individually. In addition, we use trade and quote level data to examine hypotheses regarding the source of the lower cost of the package trades. Section III analyzes the strategies of the bidders as well as the strategy of the fund manager. Specifically, we highlight differences in how liquidity providers formulate their bids, as well as the decision of the fund manager to accept or reject the lowest bid. Section IV concludes.

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[2] This is in contrast to basket, or program, trading where the exact composition of the portfolio (e.g., the S&P500) is known and the trades are all in one direction.

I. Transactions Costs, Package Trades and Blind (Principal Bid) Auctions

A. Asset Managers, the Demand for Liquidity, and Transactions Costs

The investment performance of an asset manager is a function of both the underlying investment strategy and the costs of implementing that strategy. Because the transactions costs associated with implementation can represent a significant drag on performance, the asset manager has incentives to seek out the lowest-cost forms of liquidity provision. (See Keim and Madhavan (1998) for an overview.) For example, the large portfolios managed by institutional investors frequently necessitate the trading of large blocks of individual stocks, and information or liquidity considerations may dictate that the transaction be completed quickly. A block trade in an individual stock requires a significant price concession (price impact) if sent *en masse* to the market maker for quick execution. Because of the inability of market makers to accommodate such large liquidity demands without significant price concessions, the upstairs market for large block transactions has evolved as a lower-cost mechanism for liquidity provision for the extreme liquidity demands of institutional investors (see Burdett and O'Hara (1987), Grossman (1992), and Keim and Madhavan (1996)). Nevertheless, the cost of executing block trades in the upstairs market can also be expensive, especially for illiquid stocks. For example, Keim and Madhavan (1996) report an average price impact of 4.34% for seller-initiated blocks of illiquid NYSE and Nasdaq stocks.

In the event that the asset manager does not demand such extreme immediacy, a large order (block trade) can be fragmented into smaller individual trades that are executed over a longer period of time. This softening of the demand for immediacy would reduce the price impact necessary to complete the total transaction. However, active managers may not have the luxury of such patience when the private information motivating the trade has a short half-life. Index managers also may demand greater immediacy if their portfolios are constructed to closely track an underlying index. In these cases the block still may be broken up, but must be traded over a short interval. For such managers, the cost of trading the fragmented block may still be expensive enough to offset any value-added from the investment strategy. For example, Keim and Madhavan (1997) show that *round-trip* trade costs for large orders (made up of smaller individual transactions) by institutional investors in small-cap stocks averaged 5.7 percent in the early 1990s.

B. Why Package Individual Trades for Auction?

Consider an asset manager whose investment decision process generates a list of securities transactions. Such a list might result from the periodic execution of a proprietary quantitative model that determines the investable universe for the portfolio, or from periodic meetings of an investment committee. The list of transactions might also result from a liquidity shock, such as a cash inflow or redemption. Note that the composition of trades on the list can consist of buys, sells, or a mixture of buys and sells. One option available to the manager is to execute the list of transactions individually on the in-house trade desk. However, this is potentially expensive if the objective is to trade the securities quickly because, as discussed earlier, transaction costs for liquidity demanders increase with the degree of immediacy desired.

Alternatively, the manager can sell the list to a broker for execution. When the broker agrees to assume ownership of the package and execute the trades, execution risk is transferred from the asset manager to the broker. In the arrangement between the broker and asset manager examined here, this transfer is achieved by the broker assuming ownership of the bundle of stock positions and guaranteeing to the manager the closing price at day *t-1* for each individual stock in the package. Thus, the manager is guaranteed "execution" of the package at yesterday's closing prices, and the execution risk associated with liquidating the package of trades now resides with the broker. The broker charges a commission fee for assuming this risk and providing liquidity. The fee, which is a function of the broker's expected cost of trading the package components, is presumably high enough to cover his own cost of liquidating the package (plus some profit) but lower than the manager's expected cost of executing the individual trades in-house.

Why might the broker's expected costs be lower than the manager's expected costs? First, the broker may have a large book of pending transactions (or may soon have from successful bids on other packages), and these transactions may represent the other side of many of the manager's trades already in place, resulting in the potential for low-cost crosses. Second, the broker may not be constrained by the immediacy facing the manager and, as a result, has a trading horizon that is longer than the asset manager's, permitting patient, lower-cost trading. Finally, the broker possibly has greater trading expertise than the manager as a result of the benefits from economies of scale afforded by a larger trading operation.[3] The last two items are broker-specific and are not related to the characteristics of the package and its components. The first item is jointly related to both the composition of the broker's book and the composition of the package. It is this aspect of the package that can sufficiently lower the broker's cost so that he can submit a low enough bid (below the manager's expected cost) to be successful, yet be high enough (above his own expected costs) to be profitable. Obviously, the larger the percentage of the package that can be crossed with existing positions on the broker's book, the lower the cost to the broker of executing the trades. However, within this mechanism, the broker does not know the identities of the individual securities in the package, and is provided only with limited information (sector and market cap distributions, percentage of Nasdaq stocks, etc.) concerning the degree of intersection between the package and his book. Similarly, the manager does not know the broker's true trading costs. It is this dual uncertainty – the manager doesn't know the composition of the broker's book and the broker doesn't know precisely the contents of the package – that makes the blind auction a viable mechanism.

C. The Blind (Principal Bid) Auction Process

In the blind auction mechanism, the manager puts the package of transactions up for bid in a sealed bid auction. The "price" submitted by the brokers participating in the auction is the commission fee, stated in average cents per share, they will charge to assume ownership of the package. Thus, the *lowest* submitted commission fee wins the auction. Note that the bidders are not aware of the identities of the other bidders.

Importantly, the asset manager, the seller of the package in the auction, reveals neither the identity of the securities in the package nor the individual quantities to be transferred. It is in this sense that the auction is blind. This is a key attribute of the auction - because the asset

[3] An additional advantage of a successful bid on a package of trades is that the broker can induce a large quantity of order flow by adjusting a single commission fee, which is preferable to adjusting the separate commissions for individually brokered transactions on many stocks.

manager's quantitative models are proprietary, the bidders do not know the composition of the portfolio and resulting trades. This aspect of the package trades examined here distinguishes them from program trades of index managers in which the composition of the program is known and directly related to the underlying index composition. The uncertainty for the bidders in the blind auction is a function of the degree of difficulty of the trades contained in the package, which of course is unknown.

To give some feel for the heterogeneity of the trades within a package, Panel A of Table I provides sample information for the individual trades in a package that was auctioned on October 29, 1999. The package shown is smaller, in terms of number of names and total value, than the typical package in our sample, but was chosen to illustrate the potential for uncertainty regarding the degree of trade difficulty associated with the transactions contained in these packages. First, most of the stocks are small and illiquid, with many residing in the smallest half of market capitalization for NYSE stocks. Second, the quantity of shares to be traded is large, in most cases representing a significant fraction of typical daily dollar trading volume, and in two extreme cases, representing 43 and 126 percent of each stock's average daily dollar trading volume (see the *VolRatio* variable). As mentioned previously, this information on the package composition is not revealed to the brokers bidding on the package.

Nevertheless, some of the uncertainty regarding the trade difficulty of the package is resolved prior to the bidding because information regarding the *characteristics* of the package is provided to potential bidders on the morning of the auction. The characteristics include:

(1) the number of stocks in the package;
(2) the total number of shares to be traded;
(3) the total package value (number of shares multiplied by yesterday's closing price);
(4) percentage of buys;
(5) percentage of Nasdaq stocks;
(6) the average correlation of the component securities with the S&P500;
(7) the distribution of market capitalization for the component securities;
(8) the distribution of *VolRatio* = [(Number of Shares Traded * Price) / (Average Daily Dollar Trade Volume over the previous 12 months)] * 100;

(9) the distribution of quoted spreads within the package; and

(10) the allocation of the component securities across economic sectors.

Panel B of Table I displays some summary statistics for the characteristics of the October 29, 1999 package. The information shown in Panel B is not as detailed as the distributional summary statistics given to the bidders. For example, we do not report on the industry membership and bid-ask spread quotes for the stocks in the package, information that is provided to the bidders. Nevertheless, Panel B does give some appreciation for the incomplete picture the brokers have when formulating their bids. What the potential bidders might infer from this somewhat fuzzy snapshot is that the package is not particularly large ($24.73 million in total value), is equally distributed across buys and sells, contains a substantial percentage of small-cap stocks, most of them being non-Nasdaq stocks, many of which trade in relatively illiquid markets. What this incomplete picture *doesn't* tell the bidders is that there are a number of extremely difficult trades that represent significant fractions of typical daily dollar trading volume. Nor does the information given the bidders provide any clues about potential trouble stocks that may be distressed or otherwise going through difficult times. Note that although the picture is incomplete, all the bidders are provided with this same fuzzy image.[4]

The information regarding the above characteristics is submitted to the potential bidders by 8 AM ET on the morning of the auction. Each participating bidder returns a (sealed) bid by 9 AM ET that same day. The bid represents a cents-per-share commission fee that the broker will charge the asset manager to guarantee execution at yesterday's closing prices for the trades in the package. The asset manager collects all bids and makes a decision by 9:15 AM ET (before the market opens) to either accept the lowest bid or reject all bids (and execute the trades individually). Each bidder is notified and informed whether their bid was accepted or rejected. In the case of rejection of all bids, the asset manager shares no information on the submitted bids, the outcome of the auction (i.e., was a bid accepted?), the identities of the bidders, or the identity

[4] While there is an incentive on the part of the manager to package some extremely difficult trades, two items mitigate this. First, most package trading arrangements contain a *force majeure* clause which automatically eliminates individual trades from the package that experienced a 5% price move from the previous day close to the

of the desired transactions with the bidders. In the case of a winning bid, the list of desired transactions (specifying the identity of the stocks, the direction of the trades (buy or sell), and number of shares) is transferred immediately to the winning broker. However, neither the outcome of the auction nor the list of desired transactions is revealed to the losing bidders.

If a bid is accepted, the asset manager wires the net proceeds (purchases minus sales) plus the commission (i.e., the amount of the winning bid) to the winning bidder. In addition, the winning bidder takes possession of shares (in the case of a sale) and transfers shares to the asset manager (in the case of a purchase). Two logistic issues are worth noting. First, the executed package is typically reported in London or Tokyo, thereby camouflaging the transaction. Second, individual trades within the package are cleared using the standard T+3 procedure. Thus the winning bidder has 3 days to deliver the necessary shares to accommodate the manager's purchases.

D. The Package Data

Our data contain the auction details and the contents of 83 packages of equity trades with a combined value of $7.32 billion that were auctioned over the period July 1998 through August 2000. We have the following details for every stock included in each package: the ticker symbol; a buy-sell indication; the number of shares to be traded; the exchange on which the stock trades; the average daily dollar trading volume over the previous 12 months; the closing price on the day before the auction; and market capitalization. Regarding auction information, we have the identities and bids of all the bidders for each auctioned package, as well as the decision by the asset manager to either accept the lowest bid or pass on all bids.

Table II provides summary characteristics separately for the completed and passed packages. Out of 83 packages, a winning bid was accepted for 48 packages with a combined value of $4.27 billion ("completed" packages), while 35 packages with a combined value of $3.05 billion had no bid accepted ("passed" packages). The packages range from 30 to 396 stocks of which 5 to 50% are Nasdaq stocks. The percentage of buy orders is in general near

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open on the morning of the auction. Second, the manager's reputation as a trustworthy counterparty would be jeopardized, and the set of subsequent bidders reduced, by attempting to hide difficult trades in the package.

50%, although the percentage ranges from 15 to 100%. In comparing the completed versus passed packages, the samples are similar in terms of the total value of the package, the percentage of component stocks that are Nasdaq, and the market capitalization of the component stocks. However, the completed packages tend to contain more stocks on average (163) than do the passed packages (98), while the passed packages contain a much larger trade volume per stock in the package (35,743 shares) than do the completed packages (20,651 shares).

The summary statistics in Table II also indicate that the packages are populated with very large and difficult trades, as revealed through *VolRatio* the ratio of dollar volume traded to the average daily dollar trading volume measured over the prior twelve months. Further, the passed packages contain, on average, more difficult trades than the completed packages. The average trade size of the stocks in the completed packages represents 10.81 percent of the average daily dollar volume, while the corresponding number for the passed packages is 15.21 percent. The large difference in trade difficulty between the completed and passed packages suggests that the manager's decision to pass on packages is perhaps related to relatively higher bids associated with the presence of more difficult trades in those packages. Indeed, for one of the passed packages the average dollar trade size of the component trades represented 45.3 percent of their respective average daily dollar volume. And for eight of the 35 passed packages, the average dollar trade size exceeded 50 percent of average daily dollar volume for more than 10 percent of the stocks in the package.

II. Evidence on Packaging as a Low-Cost Trading Mechanism

A. A Benchmark Trade Cost: Estimated Costs of Trading the Package Components Individually

To provide a benchmark for the costs of executing the individual trades contained in our package data, we use the model of trade costs developed in Keim and Madhavan (1997). Their model shows that equity trade costs are a function of trade venue (NYSE, Nasdaq, etc.), trade size, market capitalization and the inverse of price (a proxy for the proportional bid-ask spread). Using updated parameter estimates of their model for the 1996-97 period (just prior to the sample period for our packages) and values for the independent variables (trade size, market cap, etc.)

for the individual stocks in the packages, we estimate the cost of executing each individual component of each package and then aggregate by computing the volume-weighted trade cost for each package. This volume-weighted trade cost is a benchmark for the cost of trading this package of securities, in the specified quantities, by a typical institutional investor.

Specifically, we estimated the following model using data from Keim (2001) for a sample of domestic equity trades for 26 institutional money managers for the period April 1996 to March 1997[5] (T-statistics are in parentheses):

Buys

$$Cost_i = \underset{(-3.48)}{-0.2318} + \underset{(7.66)}{0.4803}\, D_i^{OTC} + \underset{(21.73)}{0.9563}\, TradeSize_i + \underset{(22.45)}{25.032}\, (1/P_i) - \underset{(-4.75)}{0.0973}\, \ln(Mcap_i) \quad \text{Adj.}R^2=0.05 \; (N=35{,}468)$$

Sells

$$Cost_i = \underset{(9.58)}{0.5803} + \underset{(8.50)}{0.5845}\, D_i^{OTC} + \underset{(30.21)}{1.7100}\, TradeSize_i + \underset{(6.38)}{5.3080}\, (1/P_i) - \underset{(-8.32)}{0.1713}\, \ln(Mcap_i) \quad \text{Adj.}R^2=0.05 \; (N=32{,}471)$$

As in Keim and Madhavan (1997), trade costs for this updated sample of institutional trades are significantly related to the independent variables for both buys and sells: costs are higher for Nasdaq stocks than for exchange-traded stocks, are positively related to trade size and the bid-ask spread, and are inversely related to market capitalization. Using these parameter estimates in conjunction with the corresponding characteristics for the individual components of the packages, we compute an estimate of the cost of executing the set of individual trades having those characteristics by a representative institution. Think of these estimates as the costs the asset manager (liquidity demander) would have incurred had she actually executed the trades individually. For the 83 packages in our sample, the average estimated benchmark cost of trading the package components individually is 1.867% (averaged over the individual components within a package, then across packages) with a standard deviation of 0.949%. The median estimated benchmark cost across packages is 1.806%, with a minimum (maximum) of

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[5] Note that this period was before the new Order Handling Rules were implemented across the Nasdaq market as well as before the tick size reduction on the NYSE.

0.221% (5.137%). What remains to be seen is how these estimated benchmark costs of trading the stocks individually compare with the costs to the liquidity demander associated with auctioning the securities in package form.

B. The Determinants of Brokers' Bids

While it is possible to estimate the trade costs of individual trades to the liquidity demander, it is not possible to assess the costs incurred by the brokers when trading the package securities because we do not have information on the percentage of trades within the package that can be crossed with existing positions in the broker's book. At one extreme, all the trades in the package could be crossed, and the broker's cost of providing liquidity would be zero. In this case the broker's profit from assuming responsibility for executing the package equals the commission charged. At the other extreme, all the trades in the package would have to be executed immediately in the market and, therefore, have costs equivalent to the asset manager's expected costs. In this case, the broker suffers an expected loss equal to the asset manager's expected costs minus the broker's commission. Because some positive percentage of the trades will likely be crossed with existing positions in the broker's book, the broker's expected profits (and costs) will lie between these two extremes.

What determines the costs for the trades that the broker actually executes? The broker faces the same trade-specific costs that have been defined in previous research. These costs are related to the size of the trade (i.e., the volume of shares traded), the liquidity of the market in which the stock trades, the trade venue (Nasdaq vs. NYSE), and the bid-ask spread. In the context of a package of trades, there is an additional factor that is important – a diversification effect related to the number of stocks in the package. The greater the number of stocks in a package, the greater the possibility that subsequent adverse price movements will offset each other (Axelson (1999) examines this effect in the context of bundling securities for sale; see also Gorton and Pennacchi (1993)), thereby lowering the total cost of executing the individual trades in the package.

To provide some confirmation of the determinants of the broker's expected costs of executing the trades contained in the packages, we estimate a model that includes the factors discussed above. We include the following factors to capture the main costs and benefits of assuming ownership of the package: the number of stocks in the package; the total number of shares to be traded; the skewness of *VolRatio* (defined as the ratio of the dollar value of the trade to the average daily dollar trading volume over the prior twelve months); the percentage of stocks in the package that trade on Nasdaq; and the average of the inverse of the stock price (a proxy for the proportional bid-ask spread). The regression estimated for all 83 packages in our sample yields the following results[6] (T-statistics are in parentheses)

$$Bid_i = -0.307 - 0.001 NumStocks_i + 0.008 NumShr_i + 0.017 TrSkew_i + 0.015 Nasdaq_i + 0.172 (1/P_i)$$

(2.69) (5.01) (7.02) (1.09) (5.31) (5.63)

$N = 83$; Adj. $R^2 = 0.721$

where: Bid_i is the low bid for package *i* stated as a percent of the value of the package and reported in percentage terms; $NumStocks_i$ is the number of stocks in package *i*; $NumShr_i$ is the mean number of shares traded for stocks in package *i*, in thousands of shares; $TrSkew_i$ is the estimated skewness of the distribution of *VolRatio* for stocks in the package *i*; $Nasdaq_i$ is the percentage of stocks in package *i* that trade on Nasdaq (in %); and $1/P_i$ is the mean of the ratio of 1.0 / price for the stocks in package *i*.

The regression results provide a clear characterization of the bidder's concerns regarding execution costs when submitting a bid. First, bids are lower (more aggressive), the larger the number of stocks that are being traded. This is consistent with the idea that the larger the number of stocks in a package, the greater the diversification effect in execution risk. Also, a larger number of stocks present a higher likelihood that the individual trades can be crossed internally within the bidders' current portfolio. In contrast, bids are higher (less aggressive) as the total share volume within a package increases, reflecting larger and, therefore, more difficult trades for a given number of stocks within a package. Also, bids are increasing in the degree of skewness in the distribution of trade size. These results are symptomatic of the bidder's concern that a

[6] The regression was also estimated using the average bid as the dependent variable, which yielded quantitatively and

small number of individual trades in the package might be extremely difficult to execute, perhaps representing substantial fractions of typical daily trading volume. For such packages, the cost of these few extremely difficult trades may represent a significant portion of the overall cost of trading the entire package. Lastly, bidders submit higher (less aggressive) bids, the higher the proportion of Nasdaq stocks and the lower the average price level. Huang and Stoll (1996), Keim and Madhavan (1997) and others show that institutional trade costs are higher for Nasdaq stocks than for NYSE stocks. Similarly, Harris (1994) points out that given a common fixed minimum tick size, the bid-ask spread represents a larger percentage of the stock price the lower a stock's price level. Therefore, all else equal, low priced stocks tend to be more costly to transact.

While the R-squared of the regression is high, the unexplained portion (representing 26% of the variation in bids) is not trivial and is likely attributable to the proportion of trades in the package that can be crossed in the broker's book. We will turn to this in Section III.

C. A Comparison of Package (Bid) Costs and Benchmark Trade Costs

Table III and Figure1 compare the low (winning) bid, stated as a percent of total package value, to the benchmark cost, estimated according to the model discussed in section IIA. To highlight the differences in the costs for the completed and the passed samples, the left side of Figure 1 presents results for the completed packages while the right side presents the passed packages. Within each panel, the package costs are listed in chronological order. There are several important observations. First, fluctuations in bids across packages are highly correlated with fluctuations in estimated benchmark trade costs, with a correlation of 0.82. Second, trade costs -- both estimated benchmark costs and package low bids -- are higher for the passed packages than for the completed packages. The average low bid on the passed packages (1.11%) is significantly higher than the average winning bid on the completed packages (0.67%) with a *t*-value of 8.14. Similarly, the average estimate of individual trade cost for the passed packages (2.40%) is significantly higher than for the completed packages (1.48%) with a *t*-value of 4.98. These findings confirm the inferences drawn in section I.D from the package characteristics in

qualitatively similar results.

Table II: to wit, the stocks in the passed packages are more difficult to trade than the completed packages, resulting in higher bids that have, on average, a greater likelihood of being rejected. Third, the bids are lower than the individual trade cost estimates for almost every package. Over the entire sample, the average individual trade cost is 1.87% in contrast to 0.86% for the average low bid, and the difference is significant (t=13.00). This difference is larger for the passed packages (1.30%, t=11.43) than for the traded packages (0.81%, t=8.32). An important implication of these last findings is that for the packages for which a winning bid is accepted, the manager saves, on average, an economically significant 81 basis points by auctioning the package, measured relative to the estimated benchmark cost. By the same token, the manager suffered 130 basis points of foregone savings for the 38 packages in the passed sample.

As an alternate benchmark for the individual trade costs we also computed the costs assuming the bidder traded each package trade at the opening trade on the day of the auction. While this is admittedly unrealistic since it assumes the bidder can execute large trades without any price concessions, it does provide a 'lower' bound to the costs of trading the package individually. Panel 2 of Figure 1 overlays the alternate benchmark. The mean of the alternate benchmark is 0.05%. Notice that the bid lies between the Keim-Madhavan benchmark and the lower bound estimate (alternate). The alternate benchmark provides support for the reasonableness of the Keim-Madhavan benchmark, which incorporates price concession costs, as well as our claim that package trading provides cost savings to both the manager and the bidders.

D. Basis for Cost Savings

Given the significant overall cost savings of auctioning a package of securities transactions relative to trading the individual securities internally, we examine hypotheses concerning this efficiency gain. Using individual security trade and quote-level data from the NYSE TAQ database, we argue that the cost savings are due primarily to three advantages that the bidders (liquidity providers) have over the asset manager. First and most importantly, the bidders hold potentially extensive inventories of offsetting transactions that can be used to cross a large portion of the individual package trades. Again, crossing trades presents zero costs to the bidders and is likely to represent the majority of the cost differential between the manager and bidders. Second, the bidders have less demand for immediacy than the manager when disposing of the acquired position, resulting in a longer trading horizon. We do not have evidence on how much longer their trading horizon might be, however, anecdotal evidence suggests that liquidity providers may take several days, and possibly weeks, to complete a large trade, whereas the manager's horizon is typically two or three days at most. Third, we argue that on average the bidders are likely to be better traders than the traders on the manager's internal trading desk. These efficiencies in trading are likely to come from economies of scale associated with a large trading operation and/or the proximity and linkages to exchanges, (potentially owning seats on particular exchanges or being designated market makers).

To investigate these hypotheses, we extract the trade and quote data from the TAQ database for each of the stocks within each package. For each individual stock symbol we collect all trades and quotes for the 9-day period beginning three days before the auction date and ending five days after the auction date. In preparing the trade and quote data to be used in calculating the variables of interest, we conduct the standard adjustments. First, the National Best Bid and Offer (NBBO) is calculated over the nine-day window for each stock. The NBBO represents the lowest ask price and highest bid price quoted by any trading venue making a market in the stock. Second, trades are adjusted using the Lee and Ready (1991) five second rule and are designated as buyer or seller using the Lee and Ready classification scheme. In particular, trades are designated as buyer- (seller-) initiated if the trade price is above (below) the current NBBO midpoint. For trades at the NBBO midpoint, the initiator is determined by the whether the last transaction price change was an uptick (buy) or downtick (sell).

Using the trade and quote data, we construct three variables that are relevant for our hypotheses: cumulative market-adjusted returns, net dollar trading volume in the direction of the package trade, and a trading efficiency measure. We discuss the construction of each in turn.

To construct cumulative market-adjusted returns, we compute daily returns for each stock using end-of-day quote midpoints, then the return of the Russell 2000 value index over the corresponding day is subtracted to obtain a measure of market-adjusted movement for each stock. We use the Russell 2000 Value Index to match the small cap-value characteristics of the stocks in our sample (which are dictated by the investment style of the asset manager). Having normalized the market-adjusted return of each stock to one the day before the auction, we cumulate the market-adjusted return for six days beginning on the auction day. We construct a weighted average separately for buys and sells and for 3 categories of size for the package trades, where the weights are the dollar volume of the package trade. The three size groups are: small trades, including trades that make up less than 50 percent of that stock's average daily dollar volume; medium trades, including trades between 50 and 100 percent of average daily dollar volume; and large trades, including trades larger than the average dollar volume traded in one day.

Our dollar trading volume variable is based on the difference between trading volume in the direction of the package trade versus trading volume against the direction of the package trade. For each half-hour period we sum separately the buyer-initiated and seller-initiated dollar trading volume associated with each stock in the package. Given the substantial differences in trading volume across stocks in the sample, we normalize the dollar trading volume by dividing the buyer and seller-initiated dollar trading volume by the average daily dollar trading volume for that stock (measured over the prior twelve months). We then assign a trade direction to the volume series associated with each particular trade within the package. Specifically, if a stock is to be purchased (sold) within a package, then the buyer-initiated (seller-initiated) volume is designated as volume *with* the package trade and the seller-initiated (buyer-initiated) volume is designated as volume *against* the package trade. For both series, volume with and against the package trade, we construct a weighted average (again the weights are the dollar volume of the package trade) where stocks are allocated to a category according to the stock's trade size (small, medium and large). Finally, we cumulate the difference between the volume with the package trade and the volume against the package trade. By cumulating the difference between the volume with and the volume against the trade, we have a measure of the net volume in the direction of the package trade for each half-hour period over the window.

Our third variable measures where trade prices are executed relative to the NBBO at the time of the trade. For each buyer-initiated trade we calculate the ratio of the trade price to the existing national best ask quote, while for each seller-initiated trade we calculate the ratio of the existing national best bid quote to the trade price. This ratio, which we refer to as our trading efficiency variable, provides a measure of where the transaction price occurs relative to the corresponding NBBO quote. Ratio values less than one denote trade prices within the NBBO spread that contain price improvement, while values greater than one denote trade prices that contain price concessions. Like the trading volume variable, we assign a trade direction to the buyer and seller-initiated trading efficiency series based on the direction of the associated trade within the package. This results in a trading efficiency measure with the trade and a trading efficiency measure against the trade. Similar to the net volume variable, we compute a weighted average of the trading efficiency measures separately for the 3 trade size categories (small, medium and large).

Using these data we examine the three hypotheses listed above by investigating the extent to which the manager or the bidders leave ‘footprints’ of their trading activity in the period surrounding the auction. The first hypothesis asks whether the cost differential between trading the securities as a package and trading the securities individually is due to the bidders’ ability to cross a portion of the package trades with their own inventory, as opposed to the manager trading each individual security within the package in the open market. Provided the bidder is able to cross some of the trades within the package and consequently avoid the market altogether, we should observe, on average, a smaller trading impact associated with the stocks in the completed packages relative to the passed packages. Moreover, this difference is likely to be greatest for the most difficult (largest) trades. Figure 2 compares the cumulative market-adjusted return, or price impact, surrounding the auction date for the passed packages (Panel A) and the completed packages (Panel B). Other things equal, the larger the percentage of the package’s stocks that are not traded the larger the positive (negative) slope associated with the cumulated price impact for buys (sells). Also, the larger the volume to be traded, the steeper the slope should be. Consistent with our hypothesis, the cumulative trading impact of the passed packages (Panel A) is substantially larger than the trading impact of the completed packages (Panel B) for virtually all trade sizes. Moreover, a large fraction of the trading impact appears within two trading days of the auction. Also, the larger is the trade, the greater is the price impact both for buy and sell trades as well as for passed and completed packages.

The second hypothesis is that the manager demands more immediacy than the bidders.

We argue that the patience of the bidders is likely to manifest itself as a long investment horizon, since bidders have the ability to spread trades over a longer time. One way to investigate this is to analyze the difference between the cumulative trading volume in the direction of the package trade and the cumulative trading volume against the trade. This difference in cumulative trading volume expresses the 'excess' trading volume that accumulates in the direction that the manager, and potentially the bidders, may be trading. Under the hypothesis that the bidders have a longer investment horizon, the bidder's net trading volume in the direction of the trade should be positive but less than the manager's net trading volume in the direction of the trade. Figure 3 compares the net trading volume in the direction of the trade for passed and completed packages broken out by trade size over the auction day, the subsequent day, and days 2 through 5 aggregated together. Notice that in general, the net cumulative volume measures are all positive, suggesting that there is more volume cumulating in the direction of the manager's trade than against. Consistent with our hypothesis, the net cumulative volume measures for the passed package trades are higher than the net cumulative volume measures for the completed packages trades, particularly for the small and medium size trades for the two trading days following the auction. While there appears to be less of a clear difference between the net cumulative volume measures for the large trades, the auction day results are consistent with our intuition. These results provide some evidence consistent with the bidders being able to work the trades over a longer horizon thereby incurring smaller transaction costs because of low immediacy demands.

The third hypothesis suggests that bidders are, on average, more facile traders. Despite the fact that trading expertise is extremely difficult to quantify given the complexity of the notion of a "good" trade and the many ways of measuring performance, we focus on one aspect of trading performance, namely the transaction price relative to the quoted bid-ask spread (NBBO). On one hand, the ability of a trader to execute trades inside the quoted spread suggests an ability to capture price improvement for his trade and thereby reduce the costs of immediacy. On the other hand, transacting at prices that exceed the quoted prices suggests the trader is paying a price concession, in addition to the quoted spread, to execute the order immediately or to trade in size. Thus, the ability of a trader to routinely trade inside the spread, despite trading large quantities, would be consistent with trading expertise. We measure the trading expertise of the manager and the bidders by comparing the trading efficiency variable in the direction of the package trades. If the manager's trading efficiency ratio is higher than the bidder's trading efficiency ratio, it implies that the bidders are more adept at realizing price improvement and/or avoiding price concessions for their trades as compared to the manager.

Figure 4 compares the difference in the trading efficiency measures between passed and completed packages broken out by trade size over the auction day, the subsequent day, and days 2 through 5 aggregated together. The results show that the trading efficiency measure for the completed package trades remain at or below one with few exceptions (one notable exception are small trades early the day of the auction). This suggests that the bidders are trading at or inside the quoted spread, typically avoiding price concessions when they trade. In contrast, there are sustained periods where the trading efficiency measures for the passed package trades are *above* one, most notable of these are the largest trades during the auction day. Consistent with our hypothesis, the trades the manager executes himself (passed trades) are more likely to carry with them larger transaction costs because he is executing larger trades and suffering price concessions. And as expected, it is the largest trades that generate the highest price concessions for the manager.

III. Strategies within the Blind Auction: Bidder Behavior and Manager Decisions

A. Bidder Behavior

In addition to information on the characteristics of the securities contained in the packages, we also have the individual bids (in cents per share) submitted by all competing brokers in the auctions for the packages. The number of brokers participating in an individual auction ranges from three to six. However, there were four brokers that participated regularly throughout the sample period, so the analysis we present below will focus exclusively on those four brokers[7].

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[7]The number of bids submitted by the three brokers that we excluded from the analysis ranged from three to seven, and none were winning bids.

Table IV contains summary statistics on package characteristics and broker bidding behavior reported separately by broker and by whether the broker's bid was a winning or a losing bid. Panel A reports mean characteristics of bids and packages when the broker submitted a losing bid in an auction for a package, and Panel B reports the same statistics for packages where the broker submitted the winning bid (i.e., the asset manager accepted the low bid) or the best bid (the asset manager passed on the low bid) in an auction. Each panel in Table IV reports the following separately for each broker: the bid, stated both in cents per share and as a percentage of the total value of the package; the differences between the broker's bid and (a) the winning (or lowest) bid, (b) the second best bid, and (c) the high bid; the difference between the broker's bid and the estimated benchmark trade cost, as described in section II.A; and the mean values of the package characteristics described in section I.D.

Turning first to Panel B that contains the results associated with the brokers' winning bids, a relationship is evident between the degree of trading difficulty of a package and the broker who submitted a winning bid. For example, broker A tended to submit relatively high bids for the least difficult packages – those packages with the smallest total value and that contained the largest cap (most liquid) stocks, stocks with trade volumes that represent a small percentage of average daily volume, the lowest percentage of Nasdaq stocks, and a low share volume for the component stocks. These are packages for which the estimated benchmark execution cost (1.43%) is relatively low. Consistent with this profile is a conservative bidding strategy in which broker A tended to win by just edging out the others in tight bidding. Broker A's average winning bid is just 6 basis points below the second best bid, and only 65 basis points below the estimated benchmark cost of individually executing all the implied transactions in the package.

At the other extreme, broker D submitted the lowest bids for the most difficult packages: those packages with the largest total value and that contained the smallest cap (least liquid) stocks, stocks with trade volumes that represent a large percentage of average daily volume, the highest percentage of Nasdaq stocks, and a high share volume for the component stocks. The estimated benchmark execution cost for these packages is 1.81%. In pursuing these more difficult packages, broker D is following a more aggressive bidding strategy in which the average winning bid is 20 basis points below the second best bid and a substantial 111 basis points below the estimated benchmark cost of individually executing all the implied transactions in the package. One might interpret this as evidence of the winner's curse, but remember that it is quite possible that broker D might have been able to cross many of these transactions with existing trades in its book, resulting in a low average cost of disposing of the package contents. Although we do not have direct evidence on this, we examine this possibility indirectly in the next subsection.

Brokers B and C appear to be following moderately aggressive bidding strategies that might be described as more balanced than broker D, winning with relatively high bids for packages of moderate to difficult trade characteristics. The estimated benchmark execution cost for these packages ranges from 1.84% to 2.03%. Brokers B and C submitted bids that are 10 to 15 basis points below the second best bid and just over 100 basis points below the estimated benchmark cost of individually executing all the implied transactions in the package.

The evidence in Panel A of Table IV regarding the losing bids tends to reinforce the assessment of bidding strategies sketched above. For instance, Broker A's conservative strategy is evident in the level of the losing bid relative to both the winning bid and the benchmark cost. When broker A loses, his bid is significantly higher, by 30 basis points, than the winning (or best) bid, and is 66 basis points below the benchmark cost, virtually the same difference as when he submitted the winning bid. At the other extreme, Broker D appears to submit fairly aggressive bids even when he loses, the bids being only 18 basis points higher, on average, than the winning bid. Interestingly, broker D's losing bids are only 57 basis points lower than the benchmark cost for those packages, in direct contrast to the 111 basis point difference for his winning bids, further highlighting the aggressive nature of his bidding strategy in auctions that he wins.

B. The Determinants of Bidder Behavior

The above results regarding the relation between bidding strategy and package characteristics prompt the question: Do specific package characteristics factor into the bid calculation differently across brokers? For example, one broker might attach more importance to the presence of extremely large trades in a package than another broker, perhaps because of a relatively weaker trade desk. Or one broker might attach more significance to the concentration of Nasdaq stocks within a package than to the number of names in a package because they have less access to a Nasdaq market making operations and are less concerned that they be able to cross the trades internally. To examine these issues, we estimate the empirical model of the determinants of package bids that was developed in section I.B separately for each of the four brokers in our sample:

$$Bid_i = a_0 + a_1\ NumStocks_i + a_2\ NumShr_i + a_3\ TrSkew_i + a_4\ Nasdaq_i + a_5\ (1/P_i)$$

The resulting bidding functions, estimated across both winning and losing bids, are reported in Table V.

The regression estimates in Table V show that the influence of the package characteristics on the magnitude of the submitted bids varies across brokers. The package characteristics that appear to have the largest and most significant impact on bid levels are the average of the price inverses of the stocks within the package, a proxy for the average bid-ask spread, and total shares in the package. The coefficients on price inverse and total shares are positive and significant for each of the broker regressions. As discussed earlier, both these characteristics result in higher expected trade costs for a package and, therefore, higher bids. Regarding the other characteristics, there are some differences across the brokers with respect to the extent they condition their bids on these variables. For example, Broker A's bids are not significantly related to the number of stocks in the package, the presence of excessively large trades in the package (as measured by skewness of the distribution of trade size within the package), or to the percentage of Nasdaq stocks in the portfolio. Indeed, the skewness coefficient, although insignificant, comes in negatively. These results might be evidence of a very simple bidding strategy, or evidence that Broker A expects to be able to cross many of the trades with existing positions in its portfolio so that the expected costs of executing the trades in the package is not relevant.

To assess whether the aggressiveness of a broker's bidding strategy differs in auctions in which they submit the low bid compared with auctions where they are not the low bid, we estimate a modified version of the model above, now including dummy variables that distinguish between winning and losing bids:

$$Bid_i = a_0 + a_1\, NumStocks_i + a_2\, NumShr_i + a_3\, TrSkew_i + a_4\, Nasdaq_i + a_5\, (1/P_i) + a_0'\, D^{low}_i + a_1'\, D^{low}_i *NumStocks_i + a_2'\, D^{low}_i *NumShr_i + a_3'\, D^{low}_i *TrSkew_i + a_4'\, D^{low}_i *Nasdaq_i + a_5'\, D^{low}_i *(1/P_i).$$

The model is estimated separately for each broker, and all variables are defined as above, except for the dummy variable D^{low}_i that is equal to one if the bid is a winning (or best) bid, and zero otherwise. The coefficients on the variables that are multiplied by D^{low}_i measure the difference in a variable's influence on the broker's bidding strategy between those auctions where the broker submitted the lowest bid and those where the broker's bid was not the lowest. Although very few of these coefficients are significant, the results for Broker D, who displays the most aggressive bidding strategy according to the bid information reported in Table IV, are interesting. The coefficients on the price inverse–dummy interaction variable are significantly negative, indicating Broker D significantly discounted the implied high bid-ask spreads of the stocks in these packages and submitted a significantly lower bid than he submitted for comparable packages in which he was not the low bidder. However, the caveat mentioned previously also applies here: although this may be evidence of aggressive bidding behavior resulting in winning the auction, it may also be evidence that for these particular packages Broker D may have assessed that most of the trades in the package could be crossed within its existing portfolio of positions.

C. The Manager's Decision to Accept or Reject the Low Bid

Another interesting aspect of the auction process is the decision by the asset manager to either accept the lowest bid, or pass and execute the individual trades himself. The cost savings afforded the manager through the auction mechanism is the difference between the lowest bid and the benchmark cost. This measure of cost savings is positive and significant for both completed and passed packages and, interestingly, is larger for the passed packages (see Table

III). Given this finding, it would be useful to better understand the manager's decision process regarding the acceptance of bids.

We investigate the manager's decision by estimating a probit model of the choice to accept or reject the low bid. The dependent variable equals one when the asset manager accepts the lowest bid (completed package) and zero otherwise (passed package). The explanatory variables reflect the information revealed to the manager via the distribution of bids. Specifically, we use the low bid, the difference between the low bid and the second lowest bid, and the range of the bids (difference between the highest and lowest bid). In addition, we include the benchmark cost that we estimated for each package.

Table VII presents four models to analyze the manager's decision. In each model, the coefficient estimates can be interpreted as the impact of the variable on the probability of accepting the low bid. Model 1 confirms the standard intuition that the lower (more aggressive) the low bid the higher the probability that the manager will accept the bid. Model 2 investigates how the difference between the benchmark cost and the low bid influences the choice. The coefficient suggest that the more difficult the package (the higher the benchmark cost) the more likely the manager will pass on the low bid. This result can be interpreted as the manager imposing a reservation bid above which the manager passes, irrespective of the cost of executing the individual trades. Model 3 incorporates more information about the distribution of the bids. We include the lowest bid, the difference between the lowest and second lowest bid as well as the range of the bids. As before the lower the winning bid the more likely the manager will accept the bid. In addition, the larger the range of the bids, the more likely the manager will accept. This result is consistent with a manager choosing to trade a package when the winning bid is unusually aggressive relative to the other bids (presumably because of some bidder specific advantage, like an extensive inventory). Our last model incorporates all four explanatory variables as well as dummy variables for each bidder to control for the identity of the bidders. None of the bidder dummy variables was significant. Consistent with the previous models, the low bid loads negatively and the bid range loads positively. In contrast to Model 2, the benchmark cost is insignificant. Thus, the manager appears not to condition on the identity of the bidders, and after controlling for the low bid and the range of the bids, the level of the benchmark cost does not figure into his decision on whether to accept or pass on the package.

IV. Conclusion

The equity market landscape is replete with different trading mechanisms designed to provide liquidity to market participants. Given the vast array of trading mechanisms available, the question of which one is best is an obvious question with not such an obvious answer. We explore an alternative liquidity provision mechanism whereby a liquidity demander auctions a package of trades to potential liquidity suppliers through a blind auction. The auction mechanism results in a transaction efficiency gain – our findings suggest that auctioning packages provides an 81 basis point transaction cost savings for liquidity demanders, as well as an efficient method for liquidity suppliers to acquire order flow. We present evidence that the transaction cost savings are attributable to the liquidity supplier's ability to execute the component trades of the package at lower cost than the asset manager because of the liquidity supplier's (1) ability to cross portions of the package with his own inventory, (2) longer trading horizon, and (3) greater trading expertise.

Our results have both regulatory and practitioner implications. On the regulatory side, the results suggest that the push for a consolidated, one-size-fits-all model of liquidity provision implicitly ignores the disparate needs of liquidity demanders with respect to the execution of their trades. Those needs might best be served using different trading venues with different mechanisms. Our study of the package auction process demonstrates that an alternative liquidity provision mechanism can in fact provide cost savings relative to traditional liquidity provision mechanisms. In a larger sense, the findings highlight the importance of being able to innovate via new liquidity provision mechanisms that provide trading advantages not easily duplicated on more traditional exchanges.

From the practitioner perspective, a blind auction of package trades represents an attractive liquidity provision mechanism for institutional traders given a number of recent developments that have added to the overall costs of transacting. First, recent reductions in the minimum tick size have resulted in significantly diminished quoted depth as well as displayed limit order depth. This change has likely increased transaction costs for institutional market participants who trade in large volume (Goldstein and Kavajecz (2000)). Second, the dispersion of depth across many competing trading venues has increased the search cost of finding liquidity providers for individual securities, particular, small-cap stocks. For these reasons, the package auction is an attractive alternative. In particular, auction bids are unconstrained by minimum tick sizes. Moreover, diminished cumulative depth coupled with its fragmentation among competing exchanges makes having liquidity providers come to the institution instead of conducting a counterparty search, another advantageous feature.

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Table I

Package Components and Aggregate Statistics for the October 29, 1999 Package

Panel A contains a list of the individual securities that were auctioned as a package on October 29, 1999, and reports whether the individual security transaction was a buy or a sell, the desired number of shares to be traded, and a relative measure of trade size, *VolRatio*. *VolRatio* is defined as [(Number of Shares Traded * Price) / (Average Daily Dollar Trade Volume over the previous 12 months)] * 100. Panel B presents some of the summary characteristics for the October 29, 1999 package that were provided to the bidders for their use in preparing bids for the package.

Panel A: Package Components

Ticker	Buy/Sell	Shares	*VolRatio*	Ticker	Buy/Sell	Shares	*VolRatio*
ADPT	S	2700	0.52	FNV	S	41300	12.87
AFG	B	72100	126.42	GTW	S	8200	0.50
BSC	S	4900	0.94	HIG	S	33300	6.30
CCR	S	4800	0.81	LEH	S	10700	1.70
CDD	S	27500	15.92	LRCX	S	12200	6.45
CI	B	19000	2.87	MGG	B	3700	3.19
CLE	S	106700	22.99	NSI	B	45000	42.53
CMH	S	35250	8.87	ODP	B	97600	2.71
CP	B	8900	2.33	OK	S	17850	12.40
CTX	S	20000	5.66	OSSI	B	28200	6.07
DLJ	S	21600	4.43	PCAR	B	8300	6.41
EAT	B	9700	3.12	S	B	37900	1.62
ENI	B	9000	3.78	SEG	B	98000	4.46
ETR	B	9800	1.68	UB	S	17800	7.67
FHS	B	26000	3.42	WLL	B	5500	2.31

Panel B: Aggregate package statistics

Number of Stocks	30
Total Number of Shares	843000
Average Closing Price	$37.13
Total Value of Package ($Mil)	$24.73
% of stocks that are Nasdaq	13.3
% of stocks that are Buys	50
Median market capitalization ($bill) of stocks in package	$3.878
Mean price inverse for stocks in package (%)	3.75
Mean shares traded per stock	28117
Mean (*VolRatio*) for stocks in package (%)	10.68
Skewness (*VolRatio*) for stocks in package (%)	4.55

Table II

Characteristics of Common Stock Package Trades, Reported Separately for Completed and Passed Packages

Panel A contains statistics for auctioned packages for which a bid was accepted and the package contents were transferred to the bidder. Panel B contains statistics for those packages for which the low bid was rejected and the securities in the package were individually traded by the asset manager. *VolRatio* is defined as [(Number of Shares Traded * Price) / (Average Daily Dollar Trade Volume over the previous 12 months)] * 100. Total value of the packages is $4.27 billion in Panel A and $3.05 billion in Panel B. All packages were auctioned during the period July 1998 to July 2000

	Mean	Std Dev	Min	25th	Median	75th	Max
Panel A: Completed Packages (N=48)							
Total Value of securities in the Package ($Mill)	88.97	73.33	16.36	39.03	58.08	122.36	323.25
Number of Stocks in Package	163	101	30	82	129	243	396
% of stocks that are Nasdaq	23.3	7.6	6.8	19.1	24.2	28.2	37.4
% of stocks that are buys	50.8	14.0	15.8	44.1	50.0	53.3	100.0
Mean shares traded per stock	20651	12910	3289	11743	18526	27890	66655
Mean (*VolRatio*) for stocks in Pkg (%)	10.81	6.24	1.00	5.66	10.40	14.36	26.69
Mean market cap ($ Mill) of stocks in Pkg	13358.5	11275.1	1403.2	6086.4	9583.6	13065.2	40442.6
Mean price inverse of stocks in Pkg (%)	3.79	0.82	2.05	3.27	3.88	4.30	5.80
Panel B: Passed Packages (N=35)							
Total Value of securities in the Package ($Mill)	87.26	50.11	26.97	45.82	86.85	114.03	231.31
Number of Stocks in Package	98	41	38	74	93	115	220
% of stocks that are Nasdaq	26.4	11.7	4.5	15.7	26.4	33.8	48.6
% of stocks that are buys	46.7	6.6	31.9	41.6	45.6	51.6	59.6
Mean shares traded per stock	35743	20076	11444	19052	30170	48571	80992
Mean (*VolRatio*) for stocks in Pkg (%)	15.21	9.89	4.18	8.03	12.33	19.63	45.29
Mean market cap ($ Mill) of stocks in Pkg	11534.2	10596.9	1890.4	4513.1	7000.8	14587.3	38330.0
Mean price inverse of stocks in Pkg (%)	4.06	0.98	2.74	3.00	4.16	4.90	6.29

Table III

Mean Low Bids and Estimated Benchmark Costs for Package Trades

The table reports average values for the winning (or low) auction bids and for estimates of a benchmark cost of trading the securities in the package by a typical institutional trader. Standard deviations are in parentheses. The package trades were auctioned during the period July 1998 to July 2000.

The benchmark cost is a volume-weighted average of the individual cost estimates for all the securities in the package. To obtain estimates of trade cost (commissions + impact) for each of the individual securities in the package, we use the following estimation of a model proposed by *Keim and Madhavan (1997):*

Buys: $Cost_i = -0.2318 + 0.4803D_i^{OTC} + 0.9563Trsize_i + 25.0328Pinv_i - 0.0973ln(mcap_i)$ Adj R^2=0.052
(n=35,468) (-3.48) (7.66) (21.73) (22.45) (-4.75)

Sells: $Cost_i = 0.5803 + 0.5845D_i^{OTC} + 1.7100Trsize_i + 5.3080Pinv_i - 0.1713ln(mcap_i)$ Adj R^2=0.053
(n=32,471) (9.58) (8.50) (30.21) (6.38) (-8.32)

where $Cost_i$ is one way total trade cost (price impact + broker commissions) in percent; D_i^{OTC} equals 1 if traded security *i* is Nasdaq, 0 otherwise; $Trsize_I$ equals number of shares traded / shares outstanding, in percent; $Pinv_i$ is the inverse of the closing price of security *i* on the day before the trade; and $mcap_i$ equals price of security *i* * shares outstanding, stated in billions of dollars. The parameter estimates above are from *Keim (2001).* The model is estimated for U.S. equity trades for 26 institutions for the period 4/96 to 3/97. These parameter estimates are used in conjunction with the corresponding characteristics of the individual components of the package to obtain an estimate of the cost of executing an individual trade having those characteristics by a representative institution

	All Packages (N = 83)	Completed Packages (N = 48)	Passed Packages (N = 35)	t (Passed - Traded)
Estimated Benchmark Trade Cost (%)	1.867	1.477	2.402	4.98
	(0.949)	(0.714)	(0.978)	
Winning (or Low) Bid (% of total package value)	0.855	0.672	1.106	8.14
	(0.321)	(0.217)	(0.269)	
Benchmark Cost - Bid	1.012	0.805	1.296	3.29
	(0.710)	(0.555)	(0.803)	
t (Benchmark Cost - Bid)	13.00	8.32	11.43	

Table IV
Bidding by Brokers on Blind Packages

The table presents summary statistics specific to each broker's losing bids (Panel A) and winning bids (Panel B). The top portion of each panel contains average values of each broker's losing (Panel A) and winning (Panel B) bids, reported both in cents per share and as a percentage of total package value. Also reported in the top portion of each panel are average values of the corresponding winning bids, second-best bids, worst bids, and benchmark costs (as defined in Table III) for the auctioned packages, all stated relative to the broker's bid (in percent). *VolRatio* is defined as [(Number of Shares Traded * Price) / (Average Daily Dollar Trade Volume over the previous 12 months)] * 100. The results are based on 83 packages auctioned during July 1998 to July 2000.

	Broker			
	A	**B**	**C**	**D**
Panel A: Mean Characteristics of Bids & Packages when Broker Submitted Losing Bid				
Number of Bids	60	43	56	35
Broker's Losing Bid (cents/share)	31.6	32.1	28.6	25.2
Broker's Losing Bid (%)	1.14	1.15	1.02	0.83
Winning or Best Bid (%)[1]	**-0.30**	**-0.27**	**-0.22**	**-0.18**
2nd Best Bid (%)[1]	**-0.17**	**-0.15**	**-0.08**	**-0.08**
Worst Bid (%)[1]	**0.10**	**0.13**	**0.16**	**0.18**
Benchmark Cost (%)[1]	**0.66**	**0.77**	**0.77**	**0.57**
Mean of Total Package Value ($ million)	94.4	93.9	82.8	75.8
Mean Number of Stocks in Package	139	129	145	145
Mean Percentage Nasdaq Stocks	24.1	25.5	23.9	22.1
Mean Percentage of Buys	49.4	47.9	49.8	50.9
Mean Shares Traded per Stock	28,393	28,606	24,411	20,321
Mean (*VolRatio*) (%)	12.74	13.44	11.75	9.73
Mean Mkt Cap ($ bill) of stocks in Package	12.5	10.9	13.6	16.1
Panel B: Characteristics of Bids & Packages when Broker Submitted Winning or Low Bid				
Number of Bids	7	39	25	12
Broker's Winning or Best Bid (cents/share)	25.1	22.1	27.5	19.6
Broker's Winning or Best Bid (%)	0.79	0.83	0.99	0.70
2nd Best Bid (%)[2]	**0.06**	**0.15**	**0.10**	**0.20**
Worst Bid (%)[2]	**0.34**	**0.36**	**0.36**	**0.50**
Benchmark Cost (%)[2]	**0.65**	**1.02**	**1.05**	**1.11**
Mean of Total Package Value ($ million)	51.5	81.8	101.4	120.9
Mean Number of Stocks in Package	76	145	116	200
Mean Percentage Nasdaq Stocks	22.9	23.9	26.5	23.7
Mean Percentage of Buys	51.5	50.3	47.8	46.5
Mean Shares Traded per Stock	22,973	24,872	33,081	23,671
Mean (*VolRatio*) (%)	8.15	11.96	14.32	14.36
Mean Mkt Cap ($ bill) of stocks in Package	18.8	13.8	10.9	8.4

[1] **Bold** indicates that the value is significantly different from the broker's losing bid at the .05 level.
[2] **Bold** indicates that the value is significantly different from the broker's winning bid at the .05 level.

Table V

Individual Bidding Functions for Package Auctions

The table reports estimates of the following model separately for each of the four brokers who bid on the packages in our sample

$$Bid_i = a_0 + a_1\ NumStocks_i + a_2\ NumShr_i + a_3\ TrSkew_i + a_4\ Nasdaq_i + a_5\ 1/P_i + e_i$$

where: Bid_i is the broker's bid for package *i* stated as a percent of the value of the package and reported in percentage terms; $NumStocks_i$ is the number of stocks in package *i*; $NumShr_i$ is the mean number of shares traded for stocks in package *i*, in thousands of shares; $TrSkew_i$ is the estimated skewness of the distribution of *VolRatio* for stocks in the package *i*; $Nasdaq_i$ is the percentage of stocks in package *i* that trade on Nasdaq (in %); and $1/P_i$ is the mean of the ratio of 1.0 / price for the stocks in package *i*. *VolRatio* is defined as [(Number of Shares Traded * Price) / (Average Daily Dollar Trade Volume over the previous 12 months)] * 100. The results are drawn for a total sample of 83 packages auctioned over the period July 1998 to July 2000. T-values are reported in parentheses. Values in bold are significant at the 5% level.

	Broker			
	A	**B**	**C**	**D**
Intercept	**-0.6370**	**-0.4595**	-0.1074	0.0331
	(-3.39)	**(-2.64)**	(-0.90)	(0.22)
Number of Stocks in package	-0.0003	**-0.0013**	**-0.0013**	**-0.0009**
	(-0.88)	**(-3.52)**	**(-5.05)**	**(-2.82)**
Mean Shares Traded for Stocks in Package	**0.0114**	**0.0108**	**0.0054**	0.0039
	(5.99)	**(5.94)**	**(4.28)**	(1.70)
Trade Size Skewness	0.0174	0.0325	0.0092	0.0099
	(0.63)	(1.36)	(0.56)	(0.47)
% of Stocks in Package that trade on Nasdaq	0.0058	**0.0200**	0.0040	**0.0127**
	(1.36)	**(4.61)**	(1.27)	**(3.11)**
Price Inverse (proxy for Bid-Ask Spread)	**0.3297**	**0.1899**	**0.2640**	**0.1351**
	(7.13)	**(4.11)**	**(7.68)**	**(3.51)**
Adjusted R^2	0.66	0.62	0.67	0.48
Number of Observations	67	82	81	47

Table VI

Individual Bidding Functions for Package Auctions

The table reports estimates of the following model separately for each of the four brokers who bid on the packages in our sample

$$Bid_i = a_0 + a_1\, NumStocks_i + a_2\, NumShr_i + a_3\, TrSkew_i + a_4\, Nasdaq_i + a_5\, 1/P_i + a'_0\, D^{low}{}_i +$$

$$a'_1\, numstocks_i{}^*\, D^{low}{}_i + a'_2\, NumShr_i{}^*\, D^{low}{}_i + a'_3\, TrSkew_i{}^*\, D^{low}{}_i + a'_4\, Nasdaq_i{}^*\, D^{low}{}_i + a'_5\, 1/P_i{}^* D^{low}{}_i + e_i$$

where: Bid_i is the broker's bid for package i stated as a percent of the value of the package and reported in percentage terms; $NumStocks_i$ is the number of stocks in package i; $NumShr_i$ is the mean number of shares traded for stocks in package i, in thousands of shares; $TrSkew_i$ is the estimated skewness of the distribution of *VolRatio* for stocks in the package i; $Nasdaq_i$ is the percentage of stocks in package i that trade on Nasdaq (in %); $1/P_i$ is the mean of the ratio of 1.0 / price for the stocks in package i; and $D^{low}{}_i$ is equal to one if the bid is a winning (or best) bid, and zero otherwise. *VolRatio* is defined as [(Number of Shares Traded * Price) / (Average Daily Dollar Trade Volume over the previous 12 months)] * 100. The results are drawn for a total sample of 83 packages auctioned over the period July 1998 to July 2000. T-values are reported in parentheses. Values in bold are significant at the 5% level.

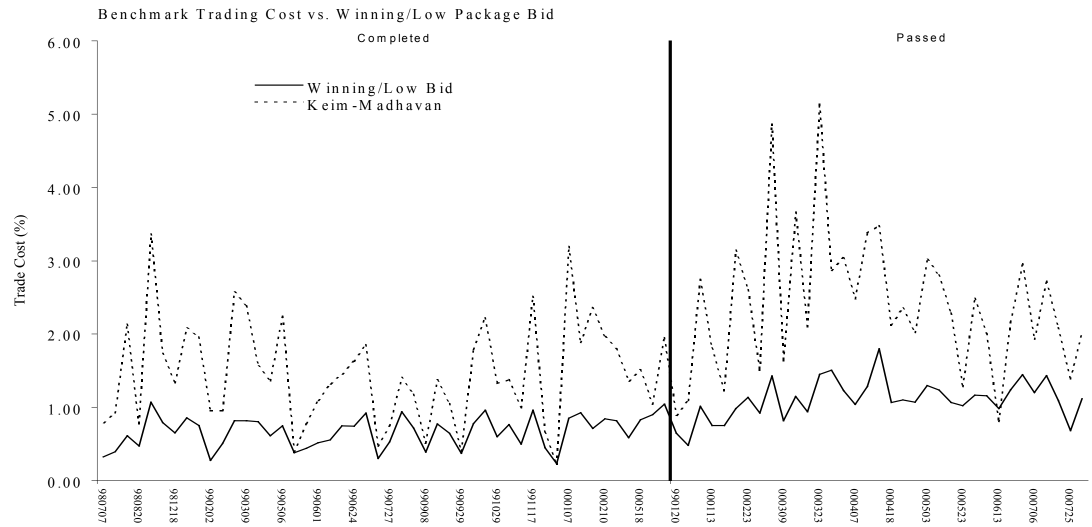
	Broker			
	A	**B**	**C**	**D**
Intercept	**-0.6065**	-0.3005	-0.1448	-0.3165
	(-3.00)	(-1.17)	(-1.25)	(-2.47)
Number of Stocks in Package	-0.0004	**-0.0013**	**-0.0014**	**-0.0012**
	(-1.03)	**(-3.00)**	**(-5.25)**	**(-3.57)**
Mean Shares Traded for Stocks in Package	**0.0119**	**0.0097**	**0.0061**	**0.0047**
	(5.74)	**(3.82)**	**(4.38)**	**(2.57)**
Trade Size Skewness	0.0192	-0.0090	0.0165	**0.0393**
	(0.68)	(-0.22)	(1.02)	**(2.23)**
% of Stocks in Package that trade on Nasdaq	0.0074	**0.0228**	0.0021	**0.0099**
	(1.69)	**(4.00)**	(0.60)	**(3.11)**
Price Inverse (proxy for Bid-Ask Spread)	**0.3147**	**0.2012**	**0.2901**	**0.2470**
	(6.53)	**(3.26)**	**(7.95)**	**(6.75)**
D^{low}	-0.0116	-0.1718	0.1566	0.5042
	(-0.01)	(-0.53)	(0.53)	(1.58)
Number of Stocks in package * D^{low}	-0.0016	-0.0001	-0.0007	0.0006
	(-0.26)	(-0.11)	(-1.03)	(1.22)
Mean Shares in Package * D^{low}	-0.0092	-0.0005	-0.0008	0.0079
	(-1.30)	(-0.15)	(-0.26)	(1.43)
Trade Size Skewness* D^{low}	0.0061	0.0492	-0.0838	-0.0507
	(0.04)	(1.02)	(-1.69)	(-1.21)
% of Stocks in Package that trade on Nasdaq* D^{low}	-0.0179	-0.0121	0.0116	0.0086
	(-0.68)	(-1.50)	(1.83)	(0.78)
Price Inverse * D^{low}	0.1712	0.0249	-0.0660	**-0.2621**
	(0.50)	(0.29)	(-0.85)	**(-3.20)**
Adjusted R^2	0.65	0.70	0.74	0.74
Number of Observations	67	82	81	47

Table VII

Probit Model of Asset Manager's Decision to Trade or Pass

This table presents the results of a probit analysis of the decision to accept the lowest submitted bid or reject all bids. The dependent variable takes on the value 1 if the packages was completed and zero otherwise. *Model 4 was also estimated using dummy variables for the individual bidders and no coefficient was significant at the 5% level. Values in bold are significant at the 1% level. Standard deviations are in parentheses.

	Model 1	Model 2	Model 3	Model 4*
Intercept	**4.15**	**0.91**	**3.90**	**3.66**
	(0.80)	**(0.27)**	**(0.90)**	**(1.06)**
Low Bid	**-4.53**		**-5.40**	**-6.02**
	(0.89)		**(1.10)**	**(1.44)**
Difference between Low bid and 2nd lowest bid			-1.64	-1.97
			(1.89)	(2.31)
Bid Range			**3.43**	**3.60**
			(1.22)	**(1.46)**
Difference between the Benchmark Cost and the Low Bid		**-0.70**		0.07
		(0.23)		(0.49)



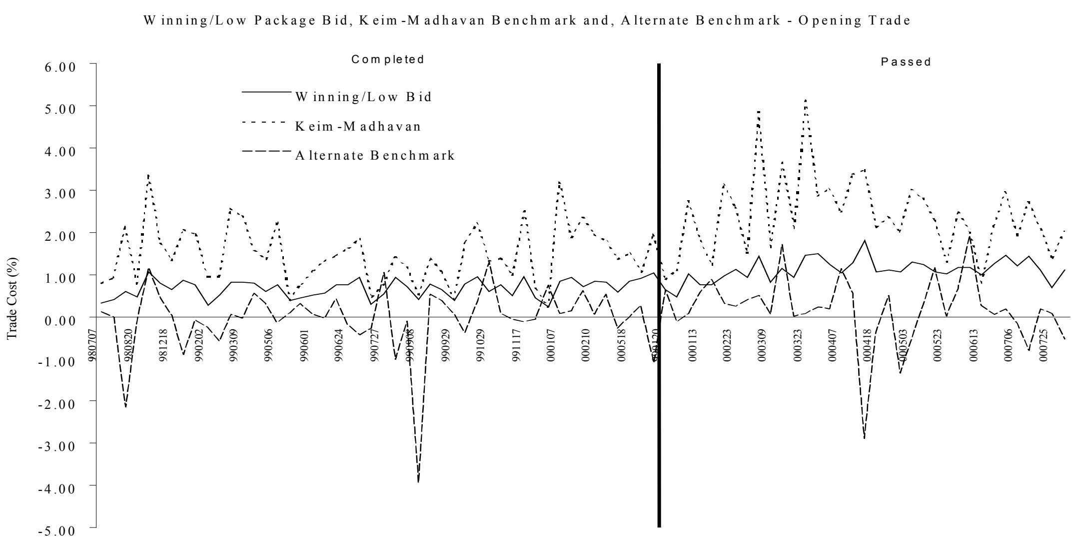


Figure 1. A Comparison of Trade Costs to Auction Bids. The Benchmark trade cost estimate is generated using the Keim-Madhavan (1997) trade cost model using data from Keim (2001). The winning/low package bid represents the winning bid in the case of a completed package and the lowest bid in the case of a passed package. The data in the completed (passed) portions of the graph are listed in chronological order.

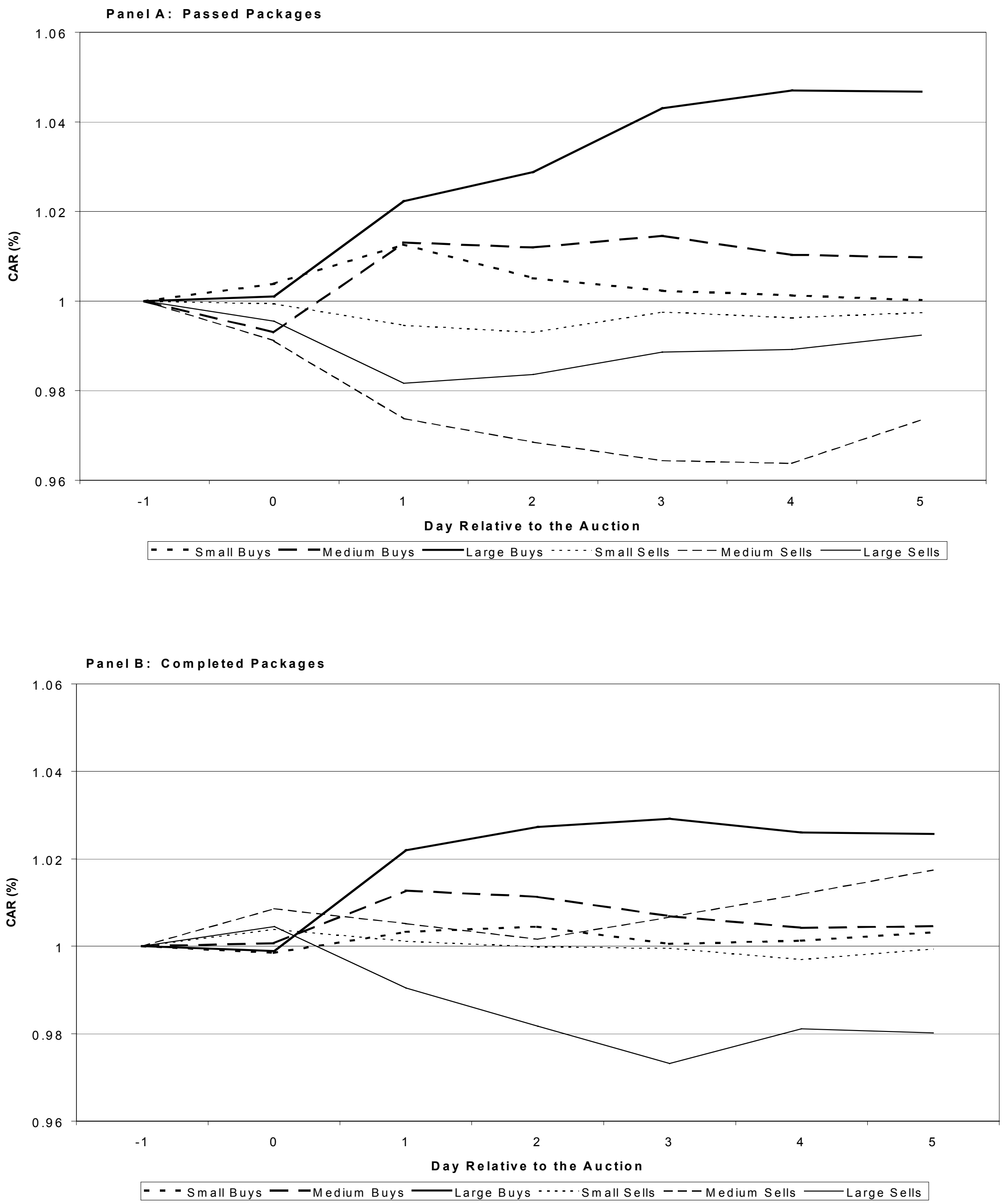


Figure 2: Cumulative Market-adjusted Returns for Passed and Completed Packages. Market-adjusted returns are constructed by subtracting the daily Russell 2000 value index return from the daily return of each stock in a package and then cumulated for six days starting on the auction day. Aggregate statistics are calculated using a weighted average of abnormal returns, where the weights are the dollar volume of the package trades. Small, medium and large trades represent less than one half, between one half and one, and more than one days worth, respectively, of average daily dollar trading volume.

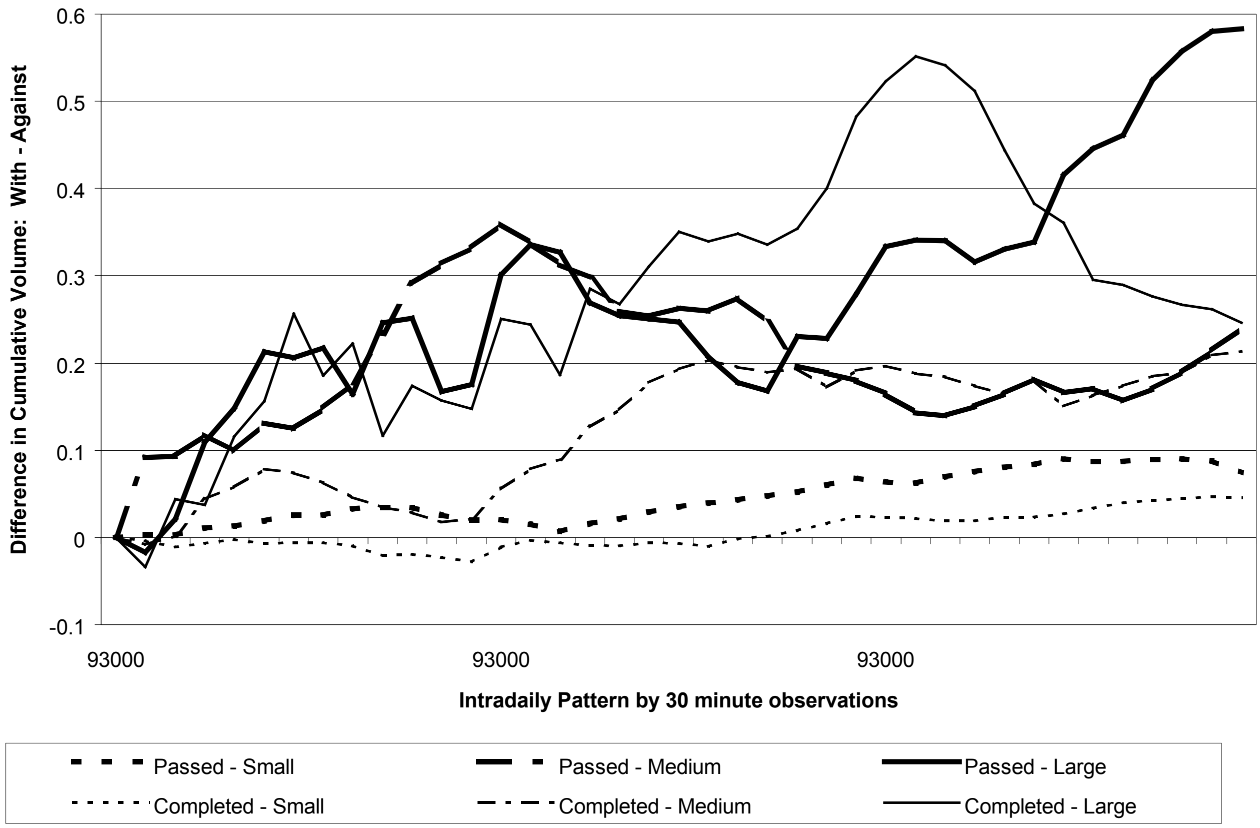


Figure 3: Cumulative Net Volume in the Direction of the Package Trades. Dollar volume is summed at 30-minute intervals and normalized by average daily dollar volume over the past 12 months, signed using Lee and Ready (1991) and then cumulated by initiator. Each series represents the weighted average of the difference between the cumulative volume in the direction of the packages trade and the cumulative volume against the package trade, where the weights are the dollar volume of the package trades. Small, medium and large trades represent less than one half, between one half and one, and more than one days worth, respectively, of average daily dollar trading volume.

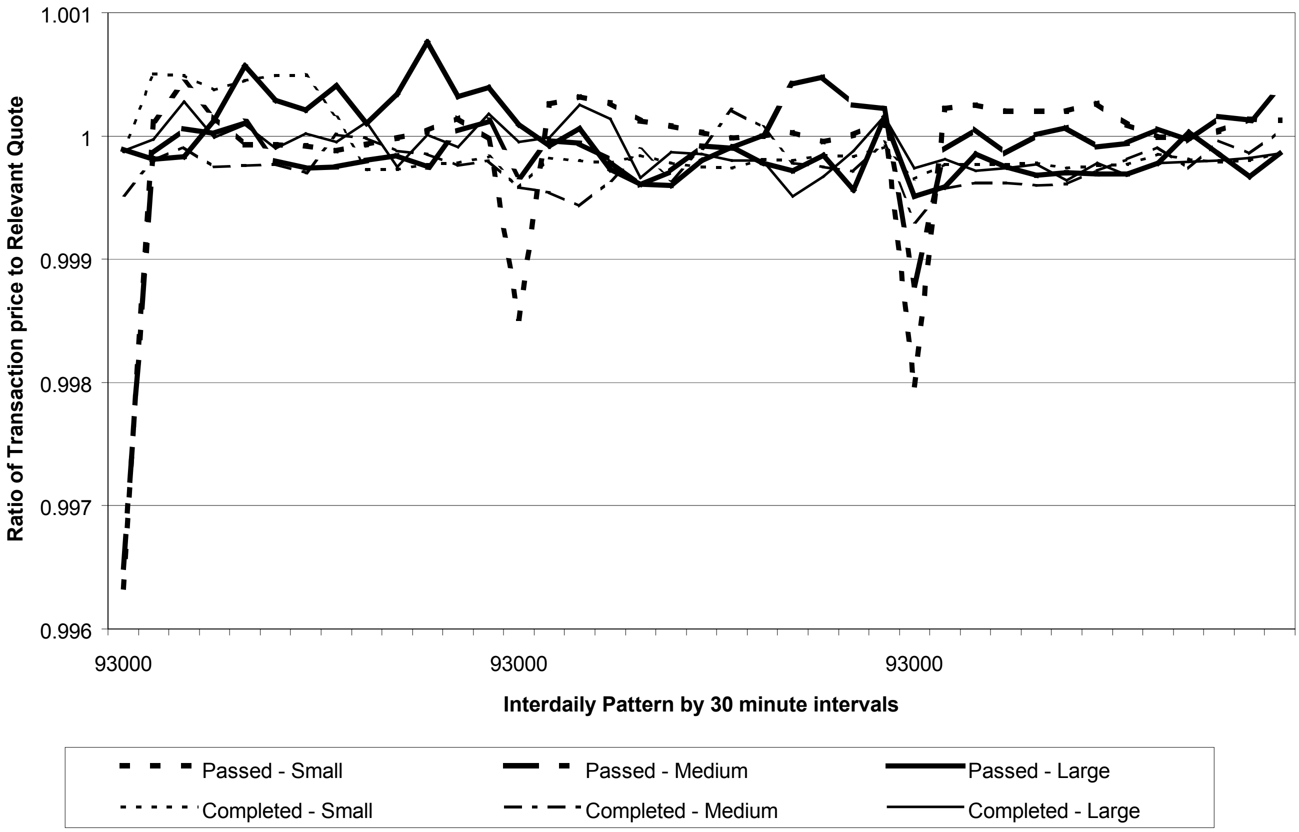


Figure 4: Trading Efficiency Measure in the Direction of the Package Trade. For each trade the ratio of the trade price to the quoted ask, in the case of a buyer-initiated trade, or the ratio of the quoted bid to the trade price, in the case of a seller-initiated trade is calculated. Weighted averages of these ratios are calculated at 30-minute intervals where the weights are dollar volume of the package trade. The initiator is determined using the Lee and Ready (1991) algorithm. Small, medium and large trades represent less than one half, between one half and one, and more than one days worth, respectively, of average daily dollar trading volume.