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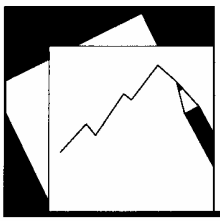

IMF Working Paper

Bidder Participation and Information in Currency Auctions

Lawrence Ausubel and Rafael Romeu

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Bidder Participation and Information in Currency Auctions

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Abstract

This paper studies the participation and performance of sophisticated versus unsophisticated auction participants in an environment with numerous bidders, uncertainty, and asymmetric information. We examine multi-unit, pay-as-bid, currency auctions conducted by the Central Bank of Venezuela. We find that sophisticated bidders outperform their less sophisticated rivals during periods of high volatility, apparently as a result of their superior information-gathering ability. The result is consistent across both quantity (sophisticated bidders win more market share) and price (sophisticated bidders pay lower premiums). The result is consistent with the view that a pay-as-bid auction format may be detrimental to participation by less-informed bidders.

JEL Classification Numbers: D44, F31, G15

Keywords: Auctions, currency auctions, pay-as-bid auctions, asymmetric information

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I. Introduction

Perhaps the most often studied issue in the economics literature on multi-unit auctions is the performance of the traditional pay-as-bid auction versus more recent alternatives. Empirical studies have generally contrasted the pay-as-bid auction (in which winning bidders pay the amounts of their winning bids) with the uniform-price auction (in which winning bidders pay a single clearing price for every unit that they win).[2] Theoretical studies have examined the properties of equilibria in the pay-as-bid and uniform-price auctions[3] as well as proposing new approaches to auctioning multiple units.[4]

The earliest critique of the pay-as-bid auction format is due to Milton Friedman. In testimony before the Joint Economic Committee of the US Congress in 1959, he argued: "If you pay the price that you bid, then it really makes a great deal of difference that you should bid very close to the final price at which the auction is going to be settled. The only way to assure that you do so is to get together with other people and arrange your bids." (Friedman, 1959) In later years, he supplemented his critique by arguing that the pay-as-bid format then used by the US Treasury "reduces participation, changes the demand schedule as it appears to the Treasury, probably raises the costs for the Treasury, and is inferior to an alternative method of bidding under which all purchasers would pay the same price." (Friedman, 1964, p. 513.) By contrast, in a uniform-price auction, "no one is deterred from bidding by fear of being stuck with an excessively high price. You do not have to be a specialist." (Friedman, 1991.)

In the current paper, we reexamine Friedman's critique, empirically, within the context of a series of recent currency auctions conducted by the Central Bank of Venezuela. Our premise is that, if asymmetric information is a problem for bidders in a pay-as-bid auction, this problem worsens in times of greater volatility and uncertainty. Thus, if limited participation by less-informed bidders is a problem generally, then it should be a bigger problem at times when their informational disadvantage is more consequential.

The dataset utilized here has a number of advantages for assessing Friedman's argument, including the ability to track sophistication levels and bidder behavior outside the auctions. Individual bids are known for all participants in all of the auctions. Notably, the failure to bid in a particular auction is also observed. It is possible to track the bidders from one auction to the next, and to match the bidders' bids with bidder-specific variables that may influence the bidding. The auctions occurred during a time period in which the relevant currency market was subject to varying levels of incomplete information, and there exist some proxies for the degree of incomplete information. And the auctions occurred at a very

[2] See, for example, Malvey, Archibald and Flynn (1996), Hortacsu (2002), Nyborg, Rydqvist and Sundaresan (2002), Keloharju, Nyborg and Rydqvist (2002) and Bindseil, Nyborg, and Strebulaev (2004).

[3] See, for example, Wilson (1979), Back and Zender (1993), Ausubel and Cramton (1996), and Wang and Zender (2002).

[4] See, for example, Vickrey (1961), Ausubel (2004), and Ausubel and Milgrom (2002).

high frequency (three times per day), meaning that the changes in volatility and uncertainty were likely to be the most important changes affecting the bidders during the sample period.

The notion of "more sophisticated" or "better informed" is operationalized empirically in this paper by looking at the size of the bidders' retail businesses: larger is equated with more sophisticated. As it turns out, more sophisticated bidders by this measure do outperform their less sophisticated colleagues, particularly during high volatility periods. This result appears in the currency auctions studied here—an environment with numerous bidders, uncertainty, and asymmetric information. Driving this information asymmetry is probably two factors. First, the relevant private information in this market is probably the order flow of customers, and the bidders with larger retail businesses are in a position to aggregate the order flow of a larger set of customers. Second, the larger bidders have the economic incentive to acquire better information-gathering and information-processing technology related to the currency markets than other bidders, meaning that they should be expected to invest in becoming more sophisticated in an informational sense.

The Venezuelan authorities turned to currency auctions to efficiently allocate foreign currency reserves when they exited a crawling peg exchange rate regime. Under this regime, authorities guaranteed a price at which they buy or sell any amount of foreign currency. Once the price of foreign exchange was determined in an auction, its results changed the value of balance sheets and portfolios; hence there was broad interest in the auctions. Information asymmetries in currency auctions originate from internal signals of economic aggregates that market participants, such as banks, create to help predict the short-run demand for foreign exchange. These signals are based on private information (such as customer order flow for dollars) that is available at very high frequencies, and they are used to form bids in the auctions.[5] Our results show how more sophisticated auction participants use these signals to outperform less sophisticated bidders, especially during periods of high uncertainty.

Our analysis departs from most previous empirical studies of auctions in two ways. First, bidder participation is treated endogenously, rather than as an exogenous statistic to be correlated with other results. In our analysis, the number of participants in a given auction is not merely a random draw. Rather, a bidder's decision to enter the auction is an integral part of her strategy space. That is, based upon her needs for currency and her private information, a bidder decides the prices and quantities to bid. We include, however, the possibility that the bidder may optimally not bid at all (or, equivalently, may bid for a zero quantity). Previous work has sometimes modeled endogenous entry into an auction using some entry cost. However, such an approach is not designed to address the issue of bidders exiting because of uncertainty or adverse market conditions, which is explicitly treated here. That this issue typically has been sidelined in the literature is understandable, considering the data requirements necessary to capture the behavior of market participants choosing not to enter the auction. The richness of our dataset enables us to examine this issue, however, our analysis is also robust to critiques regarding this issue. Specifically, one concern is that

[5] Lyons (2001) provides a general treatment of this type of informational asymmetry information in currency markets.

predicting participation in the auction also can predict bidding behavior. Our results are robust to this critique in that conditional on participation, we continue to find that more sophisticated banks outperform their less sophisticated colleagues.

Second, our study centers on who are the winners, the quantities that they win, and the prices that they pay. That is, we investigate what separates the winners from the losers during volatile times. Our answer is the sophistication of the bidder. While previous work has focused extensively on detecting a winner's curse in the aggregate outcome, we focus more specifically on finding the effect of market volatility and private information on individual bidder behavior and the disaggregated outcomes.

The next section gives institutional background. It is followed by Section III, which gives the methodology used. Descriptive statistics are presented in Section IV. Section V presents estimation results, and Section VI concludes.

II. Some Institutional Details

The data utilized come from thrice daily currency auctions held by the Venezuelan Central Bank (VCB). These auctions were instituted when, on February 15, 2002, Venezuela abandoned its fixed peg exchange rate (it stopped supporting a fixed dollar price at any quantity demanded, and instead provided a fixed daily quantity of dollars at the pay-as-bid auction price). Venezuela is one of the the top five oil exporters in the world, with a state-controlled oil industry that comprises about 20-25 percent of GDP. The daily dollar revenue generated by the national oil company's exports is surrendered to the VCB. This surrender requirement guarantees that the currency auctions play a prominent role in the provision of dollars to the private sector. In Venezuela, market participants demand dollars to spend on imports and for international asset diversification.

During the period in which the data were collected, the VCB held currency auctions each working day at 9:30 am (called auction 101), 11:00 am (called auction 102), and 1:30 pm (called auction 103). The amount to be sold in each of the three auctions was the same and was known in advance by the bidders. At the beginning of the sample, this amount was $20 million per auction (for a daily total of $60 million), which was reduced within three weeks to $15 million per auction (for a daily total of $45 million). Each participant was permitted a maximum of three bids which had to be at least $50 thousand each, and the sum of all three could be no more than 15 percent of the total to be sold in the auction (implying a maximum bid of $2.25 million per bidder in an auction, for most of the sample period). The auctions were conducted as simple pay-as-bid auctions: the bids were aggregated, the clearing price was determined, and winners (bids of at least the clearing price) paid the amounts of their bids. After each auction, the VCB published the maximum winning bid, the minimum winning bid (i.e., the clearing price), and the weighted average winning bid; and each participant was privately informed of her winnings.

At the time, the participants in the currency auctions were a diverse group of banks and exchange houses that collectively intermediated dollars in Venezuela. To service their clients' demand for dollars, they could purchase dollars at auctions, purchase dollars at the retail level from clients willing to sell, or attempt to obtain dollars from the interbank market. The latter was not as reliable an option as in the typical currency or debt market, because the Venezuelan authorities heavily regulated and taxed interbank trading and asset movements.

III. Methodology

This section outlines the empirical approach used to analyze bidding performance in auctions. This approach centers around examining if more sophisticated bidders are able to outperform their less sophisticated colleagues in times of high uncertainty. In pursuing this end, one concern is finding an accurate measure of bidding performance. In particular, previous studies have suggested that the number of bidders declines during times of uncertainty or increased volatility.[6] Given this correlation, the researcher's measurements of bidding and winning performance would reflect a different pool of bidders during volatile versus tranquil periods. If auction participants were randomly selected, observing a subset would not bias the estimations. However, it is difficult to argue that market participants bidding in the auctions are a random sample of the potential participants; more likely, there is selection bias. Hence, a naïve analysis of auction performance is subject to the critique of Heckman (1979) and, as a consequence, the approach of that study is used here.

The estimation difficulties originating from self-selection can be overcome if variables that predict participation (but not auction performance) are identified. In the case of currency auctions, such variables can be found in the microeconomics of exchange rates. This literature typically models the optimal holdings of currency market participants as driven by two effects: inventory effects and information effects.[7] Inventory effects refer to a currency dealer's need to replenish her inventory when it is running low, and to reduce her currency inventory when it runs higher than the optimal level. Information effects refer to a dealer's ability to update her estimates of variables relevant to exchange rates through her business with clients. Put crudely, by observing whether customers initiate more purchases or sales, the currency dealer can aggregate information that is dispersed across agents in the economy. The information being aggregated reflects people's expectations, risk aversion, demand for money – all variables relevant for determining the exchange rate, but unavailable at high frequencies. It is assumed here that the public's purchases of foreign currency are driven, at least in part, by variables such as their risk aversion and expectations of future inflation. Hence, the dealer who observes the most customer purchases learns the most information in real time about the aggregate state of the economy. This information serves as a basis for speculation and portfolio rebalancing and would drive a dealer to participate in the auction.

Accordingly, the probability that a bank will show up to the auction is modeled as a simple Probit using three variables dictated by microstructure exchange rate models. These are: a bank's need to replenish its inventory of dollars and corporate and private order flow. The inventory component of the estimation attempts to capture the liquidity needs of a bank, and is estimated here using the deviation from the optimal inventory (called "invdev"), as

[6] Nyborg, Rydqvist, and Sundaresan. (2002), among others.

[7] For example, Romeu (2003) models and gives evidence that inventory and information effects drive pricing and wholesale purchases in currency markets.

well as a squared deviation, and a lag of each. These are a better fit for Venezuela because of the heterogeneity of banks in the sample. Order flow is decomposed into corporate and private order flow because of the different informational value this decomposition could bring to the estimation. The variables used are sales to corporate clients (called "q_j"), and the daily dollar sales to private individuals (called "q_n"). Identification is achieved because the inventory terms are the instruments used to predict auction participation, but they are not used in the performance equation below since they are not useful in forming bidding strategies.

$$Prob\{ Auction_t\}= c +\alpha_1 invdev_t +\alpha_2 invdev_{t-1} +\alpha_3 invdev^2_t +\alpha_4 invdev^2_{t-1} + \alpha_5 q\_j_t + \alpha_3 q\_n_t + e_{t1} \quad (1)$$

Having controlled for the self-selectivity, auction performance is then modeled as depending on the bank's level of sophistication, the level of uncertainty in the market, and an interaction, and squared interaction terms. As for inventory estimation, the non-linearity in the interaction terms is a better fit for Venezuela because of the heterogeneity in bank sophistication. Order flow is included in the performance equation so as to control for information received by sales to retail clients which would contribute to the superiority of banks' bidding strategy, but not necessarily depend on banks' sophistication level.[8] Hence, the effect of bank sophistication on auction performance is captured independently of the information from the daily order flow. The resulting estimation equation is:

$$(Bidder\ Performance)_t = c + \beta_1 S_t + \beta_2 U_t + \beta_3 (S_t U_t) + \beta_4 (S_t U_t)^2 + auc2_t + auc3_t + \alpha_5 q\_j_t + \alpha_3 q\_n_t + e_{t2} \quad (2)$$

Equation (2) gives the estimating equation for bidder performance. S_t represents a measure of bank sophistication. U_t represents a measure of market-wide uncertainty on the day of the auction. The interaction terms are represented as products of *S* and *U*, and dummies for the second and third auctions of the day are represented by *auc2* and *auc3*. The coefficients on q_j_t and q_n_t capture order flow information that could be used by the banks to form bids. Heckman's correction for the latent selectivity from equation (1) is incorporated and clustering the observations around banks and using Huber/White estimates of the standard errors control for general forms of serial correlation and heteroskedasticity.[9] The estimated marginal effect of sophisticated banks' performance during volatile periods is calculated as: $\hat{\beta}_3 + 2\hat{\beta}_4(\bar{S}\bar{U})$. Note that the sophistication and uncertainty regressors are

[8] See, for example, Hortacsu and Sareen (2005).

[9] See Maddala (1983) for details of Heckman's methodology. Using V as the variance-covariance matrix, X as the regressor matrix, n is the number of banks, T is the number of observations per bank, the variance is given by:

$$V = (X'X)^{-1}\sum_{j=1}^{n} u_j' u_j (X'X)^{-1} \quad with \quad u_j = \sum_{i=1}^{T} e_i x_i \cdot$$

excluded from the selectivity equation, and hence, the marginal effect does not need to take into account a change in the probability of observing a bank.[10]

IV. Descriptive Statistics

The data used in this study provide a relatively complete depiction of the process of foreign currency intermediation in Venezuela for the period February 18 to June 7 of 2002. There are 42 unique participants in the 231 auctions that occurred in the 77 business days in the sample. Altogether, there are 5584 unique bidding strategies observed, where an auction participant wins some non-zero quantity in an auction 3437 times. Beyond observing the individual banks' bids and winnings in the auction, one is able to observe their behavior in the interbank and retail currency markets. In particular, each bank (along with approximately 30 other exchange houses that do not participate in the currency auctions) report their daily sales and purchases of dollars to retail clients and most also report inventory.

A. Bidding Performance Measures

Two market-share-based bidding performance measures are used (see Table 1 on page 22 to reference variable definitions). The first, called "wbank," is given by a bank's total winnings at an auction divided by the total amount auctioned off. The second market–share-based bidding performance measure, called "wbid," is given by a bank's total bid at an auction divided by the amount auctioned off. Two cost-performance-based variables are also used to measure bidding performance. The first, called "clpr," represents the premium a bank pays and is the signed, squared deviation of each bank's weighted mean winning bid from the auction's weighted mean winning bid. The second is called "prem," and represents the difference between a bank's weighted average price paid for winnings and the clearing price in the auction.

Figure 1 on page 18 depicts average bidding behavior in the three intraday auctions. The figure is subdivided into three panels, one for each of the three daily auctions (hence depicting intraday seasonality). Each panel depicts bidding behavior at standard bid sizes (multiples of 50,000 U.S. dollars). The top panel shows the average cover ratios for each bid size (amount won at that bid size over total amount auctioned off across all standard bid sizes), and it indicates that the majority of the dollars auctioned off go to bids in the 500,000 to 1 million U.S. dollar range. Note, however, that the average cover ratio of the largest bid size, 2.25 million U.S. dollars, also spikes, with the most disproportionate spike coming in the third auction.

The middle panel shows the average winning bid price for each bid size across the auctions. The diameter of the bubbles is scaled by the frequency or proportion of bids that appear in that category – the more bids appear in the bubble, the bigger it is. Here one

[10] This avoids the problem of interpreting a coefficient on a regressor that appears both in the prediction and selectivity equations, where a change in the value of that regressor changes both the prediction equation and the latent selection probability.

observes more winning bidders concentrating on medium size bids, and paying a higher average price as the bid size increases. The largest bid size group, however, again bucks the trend by paying a lower average price for its winnings across all three intraday auctions. That is, there is a group (of approximately the same percentage of total bidders across all three auctions) that obtains a disproportionate fraction of the dollars auctioned off at lower unit prices.

The lower panel shows the variance of prices in all three auctions by bid size. Here, the prices tend have similar volatility across bid sizes in the first auction, and show differences in the second and third auctions of the day, with no apparent pattern across standard bid sizes.

B. Bank Sophistication Measures

Five different measures of bank sophistication are used to capture any possible information advantages that may be present in the data. Two of the measures are based on an average of bank behavior throughout the sample. These aggregate measures are called "banksize" and "bksize". The measure "banksize" captures the average sales of dollars to retail clients. The measure "bksize" captures both sales to retail clients and purchases from retail clients. Both measures are constructed as the average for each bank divided by the sum of the averages for all banks (see Table 1 on page 22 for variable definitions). These measures capture potential differences suggested by market practitioners who argue that sales of dollars to retail clients are relatively more important in Venezuela due to the large government revenue in dollars from oil sales that is intermediated by the banking sector. These two measures are unchanging throughout the sample and categorize at once the sophistication level of a bank. The reasoning behind using retail-sales-based measures of sophistication is that economic information relevant for price discovery is dispersed across economic agents (for example, money demand and risk preferences). Banks with higher sales will interact with more agents, and they will have more information regarding these agents' private information about the value of the dollar. Their information advantage derives from their superior knowledge of market conditions, and of the resulting auction equilibrium prices.

Figure 2 on page 19 compares these measures of bank sophistication for all banks and exchange houses in Venezuela (the universe of potential auction participants). The figure is divided into four panels: the two left panels graph banksize, and the two right panels graph bksize. The upper graphs confine themselves to banks and exchange houses with more than 1 percent of sales, whereas the lower panels show these measures for all banks and exchange houses. The lower panels show inverted abscissa scales and the right panels show inverted ordinate scales. The graphs show large differences in the banks' relative market shares. Of 72 banks and exchange houses in the market, fewer than 20 control 99 percent of the sales, with the six largest controlling over 50 percent of the market (note the similarity to the U.S. Treasury auction market). In the bottom panel we can see the fifty or so banks and exchange houses not depicted in the top panel being dwarfed by the others' market size.

These bank sophistication measures are complimented by performance measures based on daily market share, called "bsize." Using the previous day's market share (called

lagged bsize, or "lbsize") and a moving average of the prior five business days (which is called "bsizema5"), one can observe potential dynamics in the sophistication of banks throughout the sample. These measures are intended to capture any possible changing market power within the sample period.

C. Measures of Uncertainty

Measures of uncertainty are used to gauge the effectiveness of a sophisticated bidding strategy at times when the market equilibrium is not easily discernable. The evidence presented here is based on nine measures of uncertainty. Three of these are external to the market and are used as exogenous measures of uncertainty. The other six are based on observed market volatility, or de facto uncertainty present in the market at the time of bidding.

External Uncertainty Measures

The three external measures of uncertainty are based on three assets that trade concurrently with the foreign exchange market. The first is the forward premium on the three-month currency forward for the Bolivar. The second is the Venezuelan component of JP Morgan's Emerging Market Bond Index, which characterizes country risk for Venezuela. The third is a parallel exchange rate implicitly given by the concurrent sales of equity shares of Venezuela's well-known media company, Compañía Anónima Nacional de Teléfonos de Venezuela (CANTV) on the New York Stock Exchange (as an ADR) and on the Caracas Stock Exchange. Since the same asset is sold in both markets in different currencies, their prices implicitly define exchange-rate parity. During periods of exchange controls, this last measure has become a widely observed indicator of parallel market exchange rates.

Figure 3 on page 20 graphs these three measures of volatility. The upper left shows the forward premium, which consistently shows the same periods of uncertainty. The top right panel graphs the Emerging Market Bond Index uncertainty measure (called "embi") for each day of the period. One can observe the volatility increase in the beginning of the sample, and later around mid-April, due to an increase in the macro-political uncertainty. The bottom panels compare the market exchange rate with the implicit CANTV exchange rate (called "cantvxr"). On the bottom left is the level and the estimated standard deviation, and on the bottom right panel is the CANTV exchange rate graphed against the market rate. As the points veer off the 45 degree diagonal, the equity markets are taking a different view of the exchange rate than the currency markets.

Observed Market Uncertainty Measures

Beyond the uncertainty reflected in other markets, one can also observe uncertainty in the currency market itself. Periods of uncertainty in the market are tracked using six variables. Three of these variables measure the volatility of the winning bids, while the other three measure the volatility of all bids.

Uncertainty Measures Based on Winning Bidders

The uncertainty measures that focus just on winning bidders are three. First, "spread" captures the difference between the highest and lowest winning bids in the pay-as-bid auction. This statistic is ex-post common knowledge because the Central Bank published both the highest and lowest winning bid after each auction. The second measure, "sprd," is the difference between the highest and lowest weighted winning bids at an auction. *Sprd* is analogous to *spread*, but uses weighted bids. The third measure, "sd," is the standard deviation of all weighted winning bids.

Uncertainty Measures Based on All Submitted Bids

The second group of variables examines the uncertainty present in the auctions via all bidders' demand schedules. The three measures used are: "asprd," which measures the difference between the highest and lowest weighted submitted bid; "asd" measures the standard deviation of all banks' submitted weighted bids in the auctions; "amdev" measures the average absolute deviation from the mean of all submitted weighted bids in the auction. *Asd* and *amdev* differ in that *asd* weighs outliers more. Figure 4 (page 21) shows a matrix of scatter plots of the volatility measures across the sample. The names of the variables depicted in the rows/columns are labeled along the diagonal of the matrix. The external measures of volatility tend to stray from the diagonal of each graph, indicating that they are picking up different measures of vitality than the internal measures.

V. Results

The results presented in this section point to a consistent pattern in which banks falling within the various taxonomies intended to capture sophistication show higher winnings and pay lower price for these winnings during volatile times relative to their unsophisticated competitors in the pay-your-bid auctions. Moreover, these results obtain while controlling for sophistication and market uncertainty independently, as well as for idiosyncratic information from microstructure effects in the retail market. Estimations using the variety of measures described in Section IV are presented for performance based on market share in Table 3 through Table 11 (pp. 24 –32), and for performance based on prices in Table 12 through Table 20 (pp. 33 – 41). The first set of tables considers whether sophisticated banks capture a larger share of the market than their unsophisticated colleagues, whereas the second set considers whether sophisticated banks pay more for their winnings than their less sophisticated colleagues.

Each of the tables shows two sets of estimates, one using the Heckit model in the top panel and another using ordinary least squares (OLS) in the bottom panel. The two estimation methods compliment each other in that the Heckit model controls for potential problems due to selectivity bias using inventory effects idiosyncratic to each bank to identify the model's selection. OLS estimations are used as a robustness check concerning the inventory instruments used in the selection equation. The Heckit model is employed because the results could be biased as more sophisticated bidders are the only ones to appear in the auctions at times of uncertainty. Incorporating the possible inherent truncation in the

distribution of observed bidders due to less sophisticated bidders exiting at volatile times addresses this concern. This approach, however, opens up another critique, which is that inventory pressure driving a bank to participate in the auction may also drive its bidding strategy, and hence may also predict whether they win, in essence, rendering the instruments useless. While this study does not take the view that the idiosyncratic deviation of any one bank from its own optimal inventory level could also predict successful bidding performance in the auction, it is useful to demonstrate robustness therein. That is, the bank's relative position to its idiosyncratic desired or optimal inventory level is likely to predict its participation in the auction but not its success as well. However, conditional on participation, sophisticated banks still outperform their unsophisticated colleagues. It is useful to note that banks maintain diverse and often contrarian inventory strategies throughout the observed sample.

The regression results are read as follows:

- Each table is organized around a volatility measure listed in the title. The left panel for each table uses one left-hand-side variable, and the right panel uses the other, as shown in the top row of each table.

- The uncertainty measure is shown (common for the whole table) in the row labeled "Uncertainty (U)."

- Each column represents a regression based on a different sophistication measure, labeled "Sophistication (S)" at the top of the column.

- The rows report the results, with the first column showing the names of the right hand side variables. These are:

    - The Uncertainty measure "U,"

    - The Sophistication measure "S,"

    - The interaction and squared interaction terms labeled "(U*S)" and "(U*S^2)," respectively,

    - Indicator variables for the second and third auctions of the day, labeled "auc2" and "auc3,"

    - The order flow from corporate and private customers, labeled "Order flow (corp.)" and "Order flow (priv.)," respectively.

- The last row reports the derivative of interest, given by the fitted value of $\hat{\beta}_3 + 2\hat{\beta}_4(\bar{S}\bar{U})$.

- Selection is estimated with inventory deviation, and its lag, and the squared terms of each, as well as order flow based on corporate and private customers, as shown in the middle panel of each table,

- Heckit statistics are reported at the bottom.

- Below, the OLS estimates based on the same model are shown for each combination of left-hand-side variable and sophistication measure, with relevant goodness-of-fit statistics at the bottom.

Results for Quantity-based Performance

Uncertainty Measures Based on Winning Bidders

Table 3, Table 4, Table 5, and (beginning on page 24) show that market share estimation results (market share in percent) using volatility measures based on measures of dispersion of only winning bids. The results show the interaction terms affect the winning (left panel) and the bidding (right panel). The estimated marginal impact on auction performance of an increase in uncertainty for a sophisticated bank is positive in all cases, as reported in the "Derivative" row at the bottom of each table. While the estimated coefficient on the interaction term is positive, the coefficient on the squared interaction term is negative, suggesting that while being more sophisticated during more volatile periods improves auction performance, it is a marginally declining improvement. Comparing the results, in general bidding performance is a better fit than winning performance, although both models perform well at conventional significance levels. Moreover, one contrasting result is that uncertainty alone (captured by *U*) decreases the amount that banks bid and increases winnings as a percentage of the total amount auctioned off. The effect of a higher sophistication level increases winnings and bidding in the auction. The auction indicators show that intraday bidding declines as the auctions are conducted later in the day, but winnings generally do not, which could be a sign of the "afternoon effect" discussed in the auction literature, but outside of the scope of this study. The significant estimation results of the underlying selectivity supports the hypothesis that inventory and asymmetric information effects are present in foreign exchange markets. In particular, the order flow effects are significant across regressions, and the inventory based regressors are significant in all cases except the contemporaneous squared deviation, which is notable given the difficulty in finding inventory effects in empirical microstructure models.

One way to gauge the economic significance of these results is by using the first column in each table, which reports the regression results of winnings in percent ("wbank") on bank size ("banksize"), and the "spread" (the highest less lowest winning bid, ex-post public knowledge). Of interest is interpreting the economic significance of the "Derivative" row, i.e., how economically important is the advantage of sophisticated players during volatile periods? Because *banksize* is constant throughout the sample for each bank, variations in the interaction term (*U***S*) can be interpreted to be largely driven by uncertainty measures, and the banksize variable becomes a scaling constant for each bank. Using this interpretation, consider a bank that controls 10 percent of the market, which would be one of the top three banks in this market. Using the estimated derivative of approximately 0.53 for the "spread" regression in Table 3 (page 24), if the spread is on average 19.1 Bolivares (see the average and standard deviation in Table 2, page 23), this bank will win roughly 1 percent more of the dollars auctioned off (approximately given by 0.53*0.1*19.1), and will earn an additional 0.9 percent of winnings as the spread widens by one standard deviation (17.6 Bolivares). This same logic applied to the result of estimations based on "sprd" yields an

average impact of 1.05 percent higher increase in winnings, and an additional 1.05 percent for each standard deviation increase in "sprd" of 15 Bolivares. The regressions based on "sd" show a stronger impact, with our bank winning 1.5 percent more of the total amount given the average "sd," and taking an additional 1.36 percent as the "sd" volatility measure increases by its standard deviation. Table 21 (page 42) shows similar back-of-the-envelope calculations of the economic significance of the estimated derivatives for the various volatility measures employed.

Uncertainty Measures Based on All Bidders

The results in Table 6, Table 7, and Table 8 (beginning on page 27) report the estimates of auction performance using volatility measures based on all submitted bids. Here, winners and losers are grouped together to determine the auction uncertainty. While the estimates show the same pattern of results as the previous group of estimations, this grouping magnifies the effect of being sophisticated during volatile times, as the regression is using measures of volatility that include bidders that were unable or unwilling to bid above the clearing price. In all cases, the interaction terms that capture the effect of higher sophistication during higher volatility periods remain positive and significant at the 1 percent level, and the squared interaction terms remain negative and significant, indicating the aforementioned concavity. Because the average of these variables includes losers, the regressions yield stronger effects to being sophisticated during volatile times. For example, the economic significance of the estimated effects is on average 3 percent using either "asprd" or "asd," and 2.4 percent using "amdev" as volatility measures.

Results Using External Uncertainty Measures

The results are reported in Table 9, Table 10, and Table 11 (beginning on page 30) and show estimations using external volatility measures. These measures are based on financial instruments and markets that, while pricing simultaneously, may not be as widely followed by every auction participant as the localized market events leading up to each auction itself. As a result, they offer a less satisfying, albeit consistent, fit for the proposed estimation strategy and continue to be overwhelmingly supportive of the results. In particular, all estimations show a positive impact on winnings and bidding when interacting bank sophistication and volatility, except in the particular cases where volatility is measured with the Emerging Market Bond Index ("EMBI") and bank sophistication is measured using lagged or moving averages of bsize ("lbsize" or "bsizema5"). The economic significance of the estimated derivative continues to be in the range of 3 percent, mimicking the results of the estimations that use all bidders rather than the winners (with the estimated average impact being 2.7 percent for "*CANTVSD*," and 3.7 percent for "*VBN3MCURNCY*" and "*EMBI*").

Results for Price based performance

Uncertainty Measures Based on Winning Bidders

Table 12, Table 13, and Table 14 (beginning on page 33) show the estimations on the prices paid by the distribution of winning bidders based on the varying levels of uncertainty. The

left panel of each table shows estimations using "prem" – squared premium paid by banks over the auction's clearing price, (bbidm-minbid)^2 – and the right panel shows estimations using clpr – squared premium paid by bank over the auction's minimum weighted average price, clpr=(bbidm-minwbid)^2. Note that these measures are squared to capture the non-linearities present in this market (e.g., suggested by Figure 2), but even if they were not squared, they cannot be negative because they represent the distance from a minimum and by construction are bounded from below by zero. Hence, a negative coefficient implies that a lower premium is paid, or that the bank has obtained a lower price for the dollars.

The estimates are significant at conventional levels, are correctly signed, and continue to show a pattern of concavity when interacting uncertainty and bank sophistication, implying positive but decreasing returns to bank sophistication. Here, the estimated derivatives are negative and should be interpreted as the square of the savings obtained by the bank (as the left-hand-side is squared). Hence, since the negative sign is interpreted as a savings, the square root of the absolute value is used to calculate the economic impact. In the case of the "spread" volatility measure, a bank with 10 percent "banksize" measure saves approximately 19 Bolivares given the average volatility. Throughout the sample, the price of the U.S. dollar ranged from approximately 750 to1200 Bolivares. This implies that our bank saves an average of roughly 2 percent, with an additional 1.9 percent for each incremental standard deviation in "spread," i.e., a 17 Bolivares increase in "spread." Similar calculations yield average savings of 1.9 and 2.0 percent, respectively, for "sprd" and "sd," and with estimated incremental impacts of 2.0 and 1.9 percent for their respective standard deviations.

Results Based on All Bidders

The estimates presented on Table 15 (page 36) through Table 17 show the three measures of uncertainty based on all submitted bids, which introduces more volatility into the measures of uncertainty. The data do not fit as well in these estimations as in the previous estimations which relied on volatility measures based solely on winning bids. Here the sophistication measures do not generally show significance, and the Chi square is also generally insignificant for the Heckit regressions at the 10 percent level. For the "asd" and "amdev" measures, which do show some significance in the interaction terms, the estimated derivatives continue to be signed correctly. Observing the OLS estimates, we see the fit is poor in relation to the volatility estimates based solely on winning bids.

Results Based on External Uncertainty Measures

Beginning on Table 18 (page 39), the three measures based on external asset markets. Generally these estimations are consistent with the aforementioned hypothesis but do not fit the model as well as the estimations based on the volatility of observed winning bids. The estimates continue to show concavity and the estimated derivatives are signed correctly for the "EMBI" and "CANTV" based volatility measures. As for the estimations based on all submitted bids' volatility, here the sophistication measures do not show significance, and the data fit the model poorly. The estimated impact, however, is in the range of the estimates based on winning bids' volatility, which are highly significant.

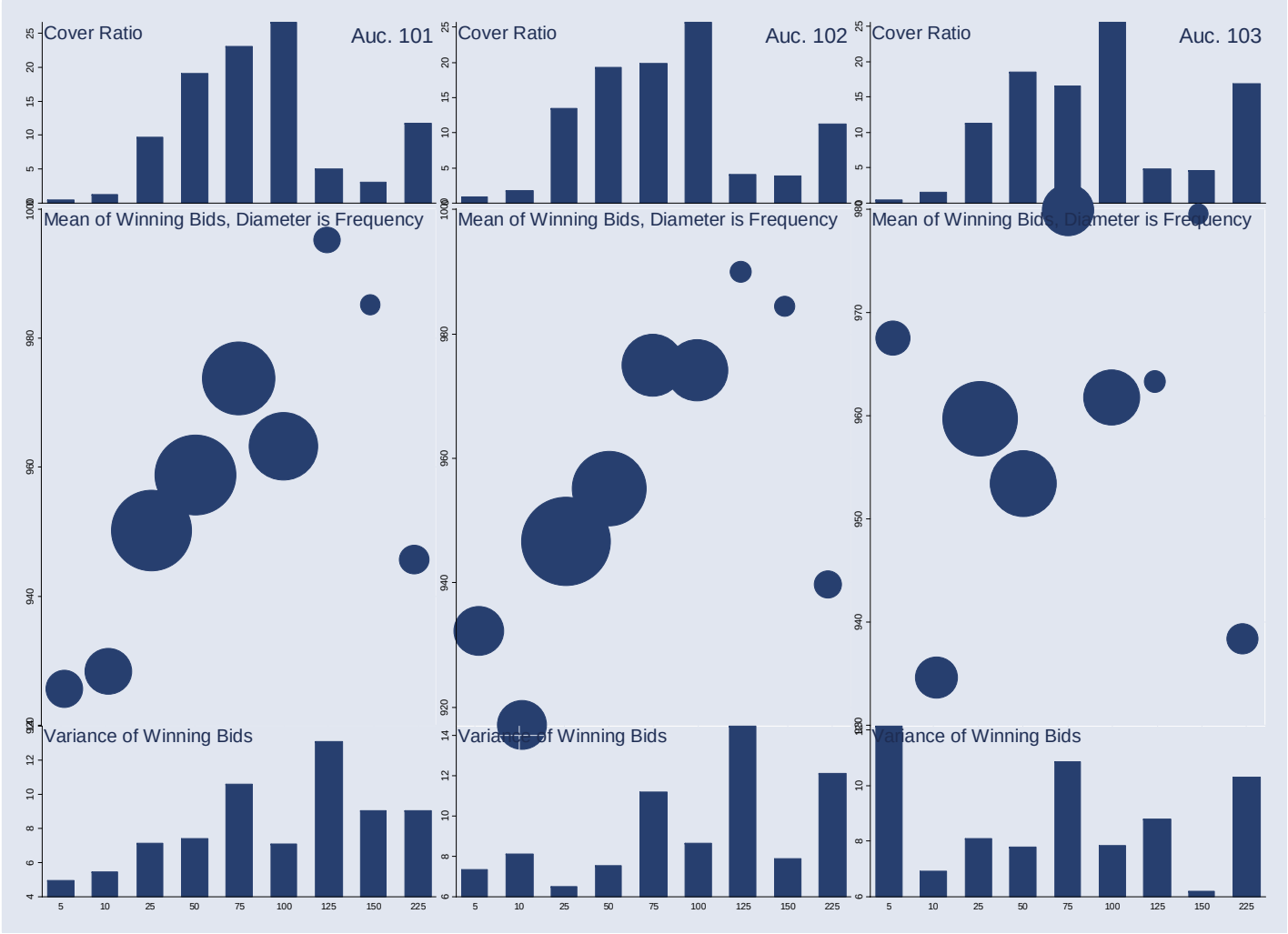
VI. Conclusion

This study has considered auction performance by contrasting bidding behaviors and outcomes, based on the interaction of the sophistication level and the amount of uncertainty at the time of the auction. The results suggest that the more sophisticated bidders gain a greater advantage over less sophisticated bidders during periods of higher volatility. Consequently, the less sophisticated bidders will tend to avoid the auctions during periods of high volatility. At all times, the more sophisticated bidders are able to outperform their less sophisticated colleagues. Our results take into account that banks must first decide whether to enter the auction or not, rather than just considering a non-random sample of auction participants. We first model whether a bank or dealer will enter an auction based on her motivation for holding currency. Then, the estimations correct the observed distribution of auction performance results to take into account the truncated bidders, who are those bidders that chose not to enter the auction. The results appear to be robust to using different measures of uncertainty and bank sophistication.

Our results appear to support Milton Friedman's claim made 45 years ago that the pay-as-bid auction format tends especially to discourage participation by uninformed bidders. If uninformed bidders are hesitant generally to participate in pay-as-bid auctions, they should be expected to be even more reluctant to participate during periods of high volatility, and that is what we observe in the data.

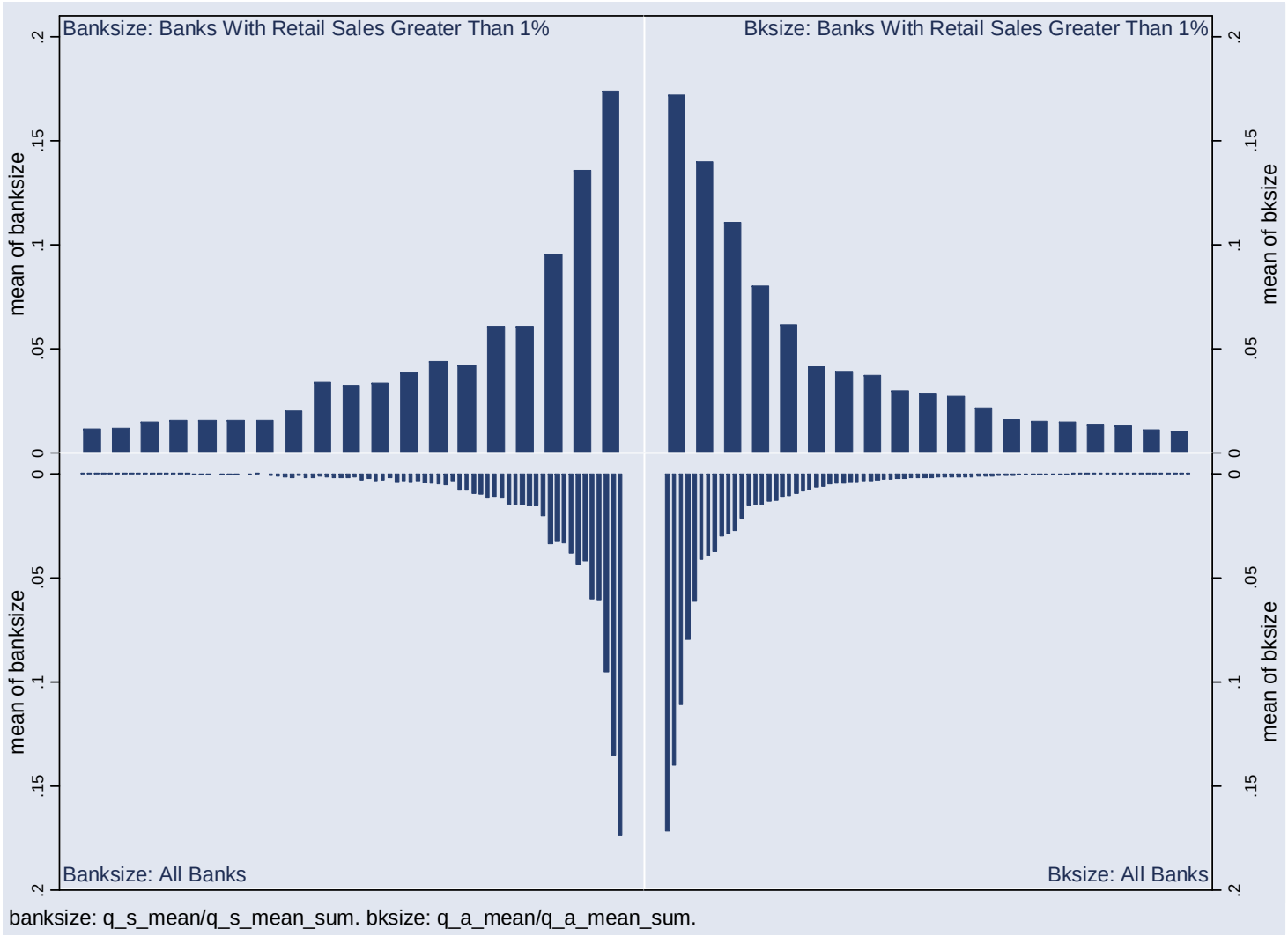
An interesting next research step would be to compare the magnitude of this effect in uniform-price auctions with pay-as-bid auctions. Friedman argued that uniform-price auctions would be less discouraging to participation, since the consequences of overbidding are smaller. However, to examine this issue in a convincing way, it would be necessary to obtain data from a situation where similar items have been auctioned using both uniform-price and pay-as-bid auctions. One possibility is the U.S. Treasury auctions, which have switched from a pay-as-bid to a uniform-price auction; another possibility is to generate data in laboratory experiments.

Figure 1. Bidding Behavior by Bid Size and Intraday Auction



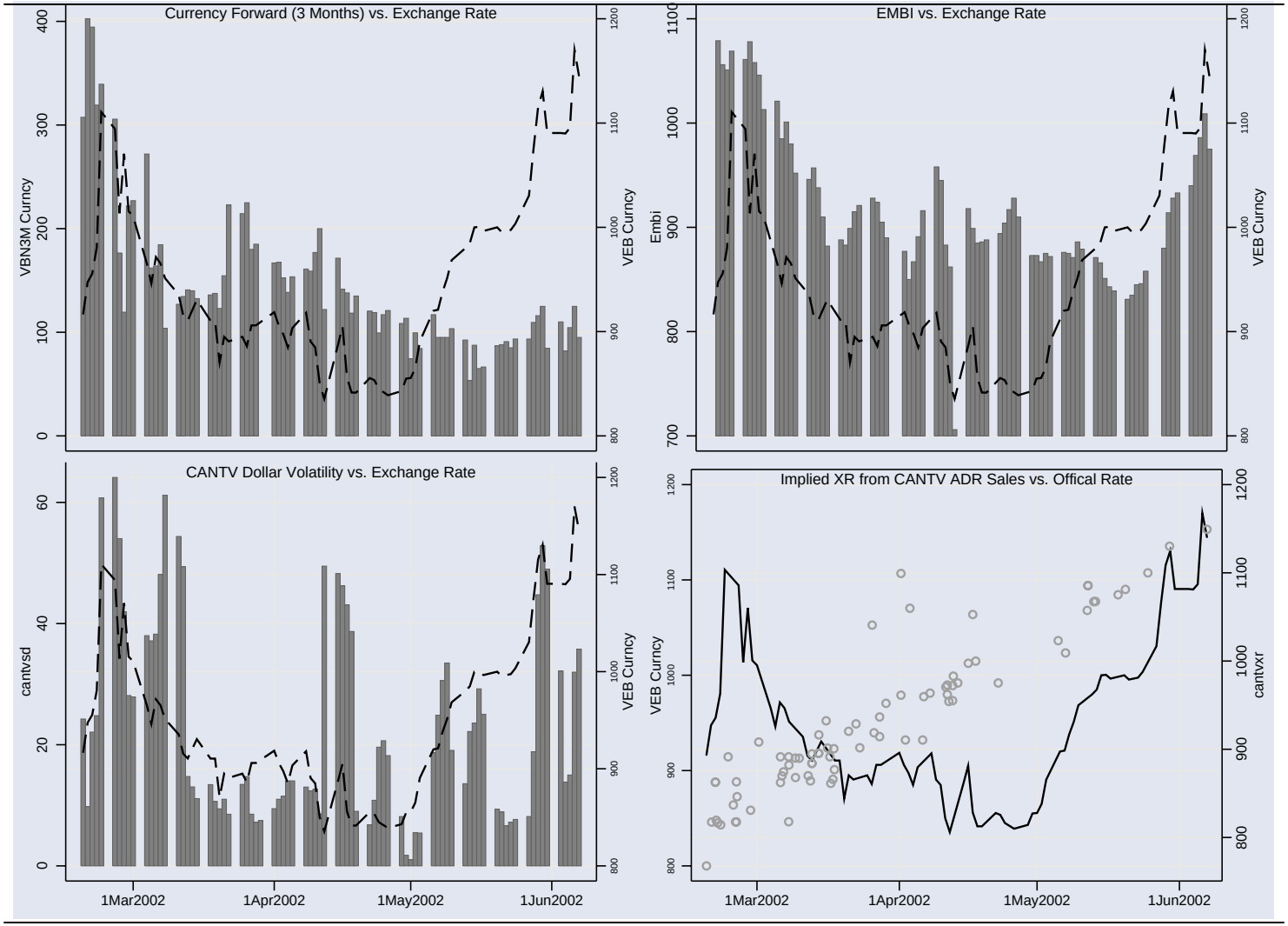
Notes: Figure 1 shows bidding behavior across the three daily auctions is depicted in order from left to right. The top panel shows the cover ratio across bid sizes; the second shows the average winning price, with the diameter of the bubbles scaled by the frequency of winnings in that bid price category. The third panel shows the variance of winning bids across bid sizes.

Figure 2. Bank Sophistication Measures



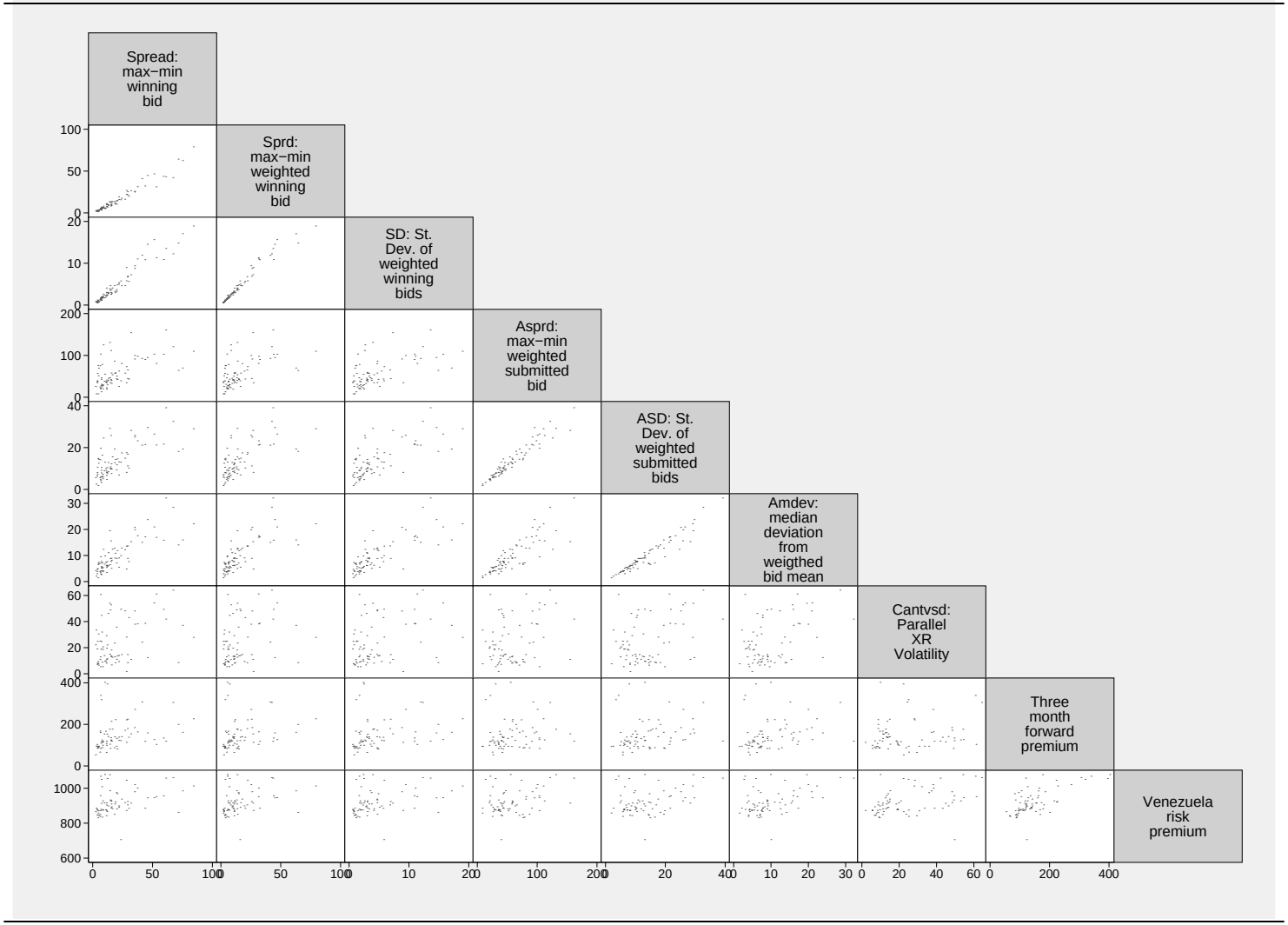
Notes: The top two panels of Figure 2 depict market share measures for banks that average at least 1 percent of daily sales. The lower two panels depict the entire market (with inverted abscissa scales). The left two panels depict banksize, the measure of average sales to retail clients, and the right panel captures bksize, the measure of sales and purchases to retail clients.

Figure 3. External Indicators of Market Volatility



Notes: Figure 3 shows the external indicators of currency market volatility. The upper left panel depicts the premium on a three month currency forward contract. The upper right panel depicts the Venezuelan component of the Emerging Market Bond Index. The lower left panel depicts the five-day standard deviation of the CANTV exchange rate. This exchange rate is plotted against the market rate in the lower right panel.

Figure 4. External and Currency Market Volatility Indicators



Notes: Figure 4 contrasts the external volatility indicators with the different measures of observed currency market volatility. The latter group is composed of six measures. The first three are drawn only for winning bids. These are: spread, sprd, and sd (definitions given along the diagonal). The last three measures are taken over all submitted bids: asprd, asd, amdev.

Table 1. Variable Definitions

	Auction Performance Measures
wbank:	weights based on a bank's percentage of total winnings per auction.
wbid:	weights based on percent bid for out of total amount auctioned off.
prem:	premium paid by bank over clearing price, squared.
clpr:	premium paid by bank over minimum weighted winning bank's price, squared.
	Sophistication Measures
banksize:	average daily retail dollar sales as a percent of all banks'
bksize:	average daily retail dollar sales and purchases as a percent of total sold in the market.
lbsize:	lagged daily sales + purchases of dollars in percent of total sold in the market.
bsizema5:	a previous five days' average of daily sales + purchases in percent of total sold in the market.
	Volatility Measures Based on Winning Bidders
spread:	the maximum less the minimum observed winning bid for each auction.
sprd:	the maximum less the minimum weighted winning bid for each auction.
sd:	the standard deviation of weighted winning bids mean at each auction, day.
	Volatility Measures Based on All Bidders
asprd:	the maximum less the minimum weighted submitted bid for each auction.
asd:	the standard deviation of weighted submitted bids mean at each auction, day.
amdev:	the mean deviation from mean of weighted submitted bids mean at each auction, day.
	Volatility Measures Based on Other Markets
cantvsd:	the five day moving standard deviation of CANTV exchange rate.
vbn3mcurncy:	the five day moving standard deviation of CANTV exchange rate.
embi:	the Venezuela component of the Emerging Market Bond Index basis point spread.
	Order Flow and Inventory Variables
q_j:	each bank's daily sales less daily purchases of dollars to corporate clients.
q_n:	each bank's daily sales less daily purchases of dollars to retail clients.
invdol:	bank daily inventory in dollars.

Notes: Table 1 gives definitions for the estimation variables.

Table 2. Descriptive Statistics

	Obs	Mean	Std. Dev.	Min	Max
wbank	5584	0.041	0.053	0.000	0.294
wbid	5584	0.088	0.060	0.003	0.750
prem	3437	151.5	563.6	0.0	13225.0
clpr	3437	130.8	509.1	0.0	12056.0
banksize	10561	0.02	0.04	0.00	0.17
bksize	10561	0.02	0.04	0.00	0.17
lbsize	9823	0.02	0.05	0.00	0.90
bsizema5	9823	0.02	0.04	0.00	0.37
spread	9702	19.16	17.58	1.85	140.00
sprd	9702	15.28	14.57	1.81	109.80
sd	9702	4.49	4.04	0.55	28.11
asprd	9702	52.21	33.73	6.98	203.12
asd	9702	12.19	7.89	1.58	40.27
amdev	9702	8.56	5.78	1.12	32.78
cantvsd	10057	24.22	16.46	1.72	64.12
vbn3mcurncy	10057	149.99	73.22	53.49	402.50
embi	9781	922.04	70.90	706.00	1079.00
q_j*	9823	0.84	2.39	-13.30	51.50
q_n*	9823	0.25	0.96	-18.60	9.11
invdev*	9739	-0.08	1.23	-16.30	17.00

* Selection equation variables.

Notes: This table shows descriptive statistics for the estimation variables for the period February 18 to June 7, 2002. While there are 42 unique banks and exchange houses participating in the auctions, there are over 70 banks and exchange houses participating in retail dollar market (hence the differences in the number of observations from one market's variables to the other).

Table 3. Assessing Quantity-Based Performance Using *Spread* for Volatility

Uncertainty (U):	wbank spread				wbid spread			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	0.012*	0.013**	-0.002	0.009	-0.027***	-0.024***	-0.043***	-0.029***
S	38.187***	36.142***	8.846	26.122***	53.136***	52.118***	14.906	37.670***
U*S	0.574	0.465	1.171***	0.681**	1.269***	1.055***	1.841***	1.290***
(U*S)^2	-0.050*	-0.038*	-0.063**	-0.045**	-0.119***	-0.096***	-0.108***	-0.096***
auc2	0.105	0.101	0.062	0.108	-0.745***	-0.746***	-0.793***	-0.729***
auc3	0.134	0.13	0.116	0.129	-0.999***	-1.001***	-1.026***	-0.998***
Order flow (corp.)	0.136**	0.159**	0.311***	0.210***	0.051	0.072	0.283***	0.151
Order flow (priv.)	0.118	0.129	0.223	0.149	0.456**	0.463*	0.599**	0.494**
Derivative	0.530	0.432	1.109	0.636	1.166	0.972	1.734	1.193
Underlying Selectivity Estimation								
Inventory dev.	0.167**	0.168**	0.171**	0.173**	0.137**	0.138**	0.142**	0.142**
Lag Inv. Dev.	-0.088***	-0.088***	-0.086***	-0.084***	-0.082**	-0.083**	-0.080**	-0.079**
(Inventory dev.)^2	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
(Lag Inv. Dev.)^2	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
Order flow (corp.)	0.222***	0.223***	0.219***	0.222***	0.214***	0.215***	0.213***	0.214***
Order flow (priv.)	0.316***	0.317***	0.306***	0.314***	0.294***	0.295***	0.289***	0.293***
rho	-0.59	-0.59	-0.57	-0.59	-0.33	-0.34	-0.33	-0.34
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
OLS Estimates of Information and Bidder Participation								
U	0.011*	0.012**	-0.001	0.009	-0.027***	-0.023**	-0.042***	-0.029***
S	34.729***	32.790***	7.926	22.596***	51.990***	50.970***	14.742	36.617***
U*S	0.723*	0.607*	1.186***	0.823**	1.335***	1.117***	1.848***	1.352***
(U*S)^2	-0.063**	-0.050**	-0.066***	-0.061**	-0.125***	-0.103**	-0.110***	-0.104***
auc2	0.112	0.111	0.08	0.116	-0.718***	-0.718***	-0.762***	-0.704***
auc3	0.176	0.174	0.159	0.172	-0.990***	-0.990***	-1.015***	-0.995***
Order flow (corp.)	0.360***	0.384***	0.524***	0.442***	0.177*	0.200*	0.409***	0.281**
Order flow (priv.)	0.437***	0.449***	0.538***	0.462***	0.667**	0.677**	0.815**	0.692***
Derivative	0.67	0.56	1.12	0.76	1.23	1.03	1.74	1.25
R^2	0.25	0.25	0.22	0.24	0.29	0.29	0.25	0.29
F	14.5	18.5	24.9	21.6	25.9	31.1	14.9	22.0
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: The upper panel in Table 3 shows estimation with selectivity, and the lower panel shows estimation with OLS. For each estimation, the left panel shows estimates using wbank (as the left-hand-side variable) -- bank winnings as a percentage of the total amount auctioned off, and the right panel shows estimates using wbid -- bank bidding as a percentage of the total amount auctioned off. The uncertainty and sophistication measures are reported across the top of the table, and the results are reported in the row labeled "U" and "S" respectively. "S," bank sophistication based on market share, is given by: banksize (average retail sales), bksize (average retail sales and purchases), lbsize (previous days retail customer sales), bsizema5 (five-day moving average of retail sales). The rows labeled "S*U" and "S*U^2" report the interaction and squared interaction terms, respectively, and "auc2" and "auc3" report indicator variables for the second and third auctions of the day. The selection equation uses the deviation from the average inventory over the past five days, the order flow from corporate and non-corporate customers. Statistics are reported in the bottom panel.

Table 4. Assessing Quantity-Based Performance Using *Sprd* for Volatility

Uncertainty (U):	wbank sprd				wbid sprd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	0.013*	0.015**	-0.003	0.01	-0.034***	-0.030***	-0.054***	-0.037***
S	37.562***	35.403***	8.859	25.809***	54.802***	53.316***	15.723	38.679***
U*S	0.771**	0.654**	1.441***	0.895***	1.396***	1.192***	2.142***	1.512***
(U*S)^2	-0.079**	-0.063**	-0.090***	-0.071**	-0.158***	-0.133***	-0.148***	-0.138***
auc2	0.092	0.089	0.048	0.094	-0.754***	-0.754***	-0.803***	-0.740***
auc3	0.1	0.097	0.077	0.094	-0.997***	-0.997***	-1.026***	-0.998***
Order flow (corp.)	0.137**	0.160**	0.313***	0.211***	0.048	0.07	0.287***	0.15
Order flow (priv.)	0.126	0.136	0.239	0.158	0.467**	0.473**	0.621**	0.508**
Derivative	0.716	0.610	1.370	0.838	1.286	1.100	2.026	1.402
Underlying Selectivity Estimation								
Inventory dev.	0.167**	0.168**	0.172**	0.173**	0.138**	0.138**	0.143**	0.143**
Lag Inv. Dev.	-0.088***	-0.088***	-0.086***	-0.084***	-0.082**	-0.083**	-0.080**	-0.079**
(Inventory dev.)^2	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
(Lag Inv. Dev.)^2	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
Order flow (corp.)	0.222***	0.223***	0.219***	0.222***	0.214***	0.215***	0.213***	0.214***
Order flow (priv.)	0.316***	0.316***	0.306***	0.314***	0.294***	0.295***	0.289***	0.293***
rho	-0.59	-0.59	-0.57	-0.59	-0.33	-0.34	-0.33	-0.34
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
OLS Estimates of Information and Bidder Participation								
U	0.012	0.013**	-0.002	0.009	-0.033***	-0.030***	-0.053***	-0.037***
S	34.143***	32.047***	7.909	22.303***	53.643***	52.147***	15.531	37.791***
U*S	0.941**	0.823**	1.447***	1.076***	1.469***	1.264***	2.145***	1.585***
(U*S)^2	-0.095***	-0.079***	-0.093***	-0.095***	-0.166***	-0.141***	-0.149***	-0.147***
auc2	0.098	0.096	0.066	0.097	-0.728***	-0.727***	-0.773***	-0.720***
auc3	0.139	0.138	0.119	0.132	-0.990***	-0.989***	-1.018***	-0.999***
Order flow (corp.)	0.361***	0.384***	0.526***	0.441***	0.176*	0.200*	0.416***	0.279**
Order flow (priv.)	0.446***	0.457***	0.555***	0.474***	0.682**	0.690**	0.840**	0.709***
Derivative	0.88	0.77	1.37	1.00	1.35	1.17	2.03	1.47
R^2	0.25	0.25	0.22	0.24	0.29	0.29	0.25	0.29
F	21.0	18.6	32.4	22.4	23.3	28.8	12.5	19.7
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 5. Assessing Quantity-Based Performance Using *Sd* for Volatility

Uncertainty (U):	wbank sd				wbid sd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	0.035	0.042*	-0.021	0.025	-0.125***	-0.109***	-0.193***	-0.133***
S	35.366***	33.435***	7.631	23.836***	51.178***	50.061***	14.003	35.585***
U*S	3.675**	3.137**	5.883***	4.071***	6.730***	5.803***	8.910***	7.005***
(U*S)^2	-1.438***	-1.180***	-1.509***	-1.313***	-2.906***	-2.486***	-2.517***	-2.567***
auc2	0.11	0.107	0.069	0.115	-0.758***	-0.758***	-0.801***	-0.740***
auc3	0.104	0.101	0.081	0.098	-1.000***	-1.000***	-1.029***	-1.000***
Order flow (corp.)	0.138**	0.162**	0.307***	0.212***	0.051	0.074	0.279***	0.152
Order flow (priv.)	0.123	0.133	0.231	0.152	0.460**	0.466*	0.605**	0.496**
Derivative	3.382	2.897	5.534	3.764	6.139	5.297	8.327	6.404
Underlying Selectivity Estimation								
Inventory dev.	0.167**	0.168**	0.171**	0.172**	0.137**	0.138**	0.142**	0.142**
Lag Inv. Dev.	-0.088***	-0.088***	-0.086***	-0.084***	-0.083**	-0.083**	-0.080**	-0.079**
$(\text{Inventory dev.})^2$	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
$(\text{Lag Inv. Dev.})^2$	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
Order flow (corp.)	0.222***	0.223***	0.220***	0.222***	0.214***	0.215***	0.213***	0.214***
Order flow (priv.)	0.315***	0.316***	0.306***	0.313***	0.294***	0.294***	0.289***	0.292***
rho	-0.58	-0.59	-0.57	-0.58	-0.33	-0.33	-0.33	-0.33
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
OLS Estimates of Information and Bidder Participation								
U	0.027	0.035	-0.018	0.02	-0.125***	-0.109**	-0.189***	-0.131***
S	31.770***	29.893***	6.706	20.358***	49.957***	48.819***	13.798	35.347***
U*S	4.365***	3.822***	5.949***	4.753***	7.026***	6.092***	8.947***	7.002***
(U*S)^2	-1.679***	-1.418***	-1.558***	-1.614***	-3.022***	-2.598***	-2.548***	-2.537***
auc2	0.117	0.115	0.088	0.118	-0.731***	-0.731***	-0.772***	-0.721***
auc3	0.142	0.141	0.122	0.134	-0.994***	-0.993***	-1.021***	-1.005***
Order flow (corp.)	0.362***	0.385***	0.519***	0.439***	0.176*	0.201*	0.405***	0.275**
Order flow (priv.)	0.441***	0.453***	0.545***	0.467***	0.669**	0.679**	0.820**	0.697***
Derivative	4.02	3.53	5.59	4.38	6.41	5.56	8.36	6.41
R^2	0.25	0.25	0.23	0.24	0.29	0.29	0.26	0.29
F	24.0	20.6	35.7	24.0	31.0	34.1	15.0	24.5
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 6. Assessing Quantity-Based Performance Using *Asprd* for Volatility

Uncertainty (U):	wbank asprd				wbid asprd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
			Heckit Estimates of Information and Bidder Participation					
U	-0.006**	-0.005*	-0.009***	-0.009***	-0.007	-0.004	-0.008	-0.009
S	26.977***	24.940***	9.622**	13.419**	39.328***	38.692***	19.845***	20.715**
U*S	0.648***	0.612***	0.683***	0.789***	1.035***	0.949***	0.953***	1.248***
(U*S)^2	-0.030***	-0.029***	-0.023***	-0.033***	-0.049***	-0.045***	-0.035***	-0.054***
auc2	0.127	0.123	0.107	0.137	-0.568***	-0.572***	-0.595***	-0.544***
auc3	0.137	0.133	0.143	0.13	-0.920***	-0.922***	-0.905***	-0.921***
Order flow (corp.)	0.156**	0.180***	0.254***	0.223***	0.079	0.101	0.206**	0.172*
Order flow (priv.)	0.138	0.149	0.202	0.145	0.480**	0.489**	0.569**	0.487***
Derivative	0.577	0.545	0.622	0.699	0.920	0.841	0.859	1.099
			Underlying Selectivity Estimation					
Inventory dev.	0.167**	0.168**	0.169**	0.172**	0.137**	0.137**	0.140**	0.141**
Lag Inv. Dev.	-0.087***	-0.088***	-0.085***	-0.083***	-0.082**	-0.082**	-0.079**	-0.078**
(Inventory dev.)^2	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
(Lag Inv. Dev.)^2	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.008***
Order flow (corp.)	0.221***	0.222***	0.222***	0.222***	0.213***	0.213***	0.214***	0.213***
Order flow (priv.)	0.313***	0.314***	0.311***	0.312***	0.292***	0.293***	0.292***	0.291***
rho	-0.58	-0.58	-0.58	-0.59	-0.31	-0.32	-0.32	-0.32
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
			OLS Estimates of Information and Bidder Participation					
U	-0.007**	-0.006**	-0.009***	-0.009***	-0.007	-0.005	-0.008	-0.009
S	23.264***	21.208***	8.740**	10.345*	38.038***	37.321***	19.712***	21.589***
U*S	0.716***	0.682***	0.684***	0.832***	1.066***	0.980***	0.956***	1.208***
(U*S)^2	-0.032***	-0.031***	-0.023***	-0.034***	-0.050***	-0.047***	-0.035***	-0.052***
auc2	0.144	0.141	0.124	0.146	-0.538***	-0.542***	-0.567***	-0.530***
auc3	0.178	0.176	0.183	0.164	-0.910***	-0.912***	-0.896***	-0.927***
Order flow (corp.)	0.377***	0.401***	0.469***	0.447***	0.196*	0.221**	0.327***	0.284**
Order flow (priv.)	0.455***	0.468***	0.521***	0.465***	0.679**	0.692**	0.778**	0.680***
Derivative	0.64	0.61	0.62	0.74	0.95	0.87	0.86	1.07
R^2	0.25	0.25	0.24	0.25	0.30	0.31	0.28	0.31
F	77.0	85.2	60.0	69.9	29.3	30.4	19.4	31.4
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 7. Assessing Quantity-Based Performance Using *Asd* for Volatility

Uncertainty (U):	wbank asd				wbid asd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	-0.015	-0.01	-0.030**	-0.024*	-0.047**	-0.036	-0.051**	-0.055**
S	27.338***	25.411***	8.774**	13.719**	36.737***	36.227***	17.968***	19.506**
U*S	2.742***	2.557***	3.179***	3.339***	4.899***	4.486***	4.479***	5.549***
(U*S)^2	-0.541***	-0.506***	-0.469***	-0.594***	-0.989***	-0.917***	-0.708***	-1.032***
auc2	0.146	0.14	0.124	0.158	-0.598***	-0.604***	-0.632***	-0.575***
auc3	0.172	0.168	0.166	0.173	-0.916***	-0.919***	-0.926***	-0.908***
Order flow (corp.)	0.150**	0.173**	0.248***	0.218***	0.076	0.099	0.200**	0.168*
Order flow (priv.)	0.113	0.124	0.178	0.123	0.449**	0.459**	0.542**	0.458**
Derivative	2.444	2.278	2.884	2.961	4.354	3.980	4.033	4.893
Underlying Selectivity Estimation								
Inventory dev.	0.166**	0.167**	0.169**	0.171**	0.136**	0.137**	0.139**	0.140**
Lag Inv. Dev.	-0.087***	-0.088***	-0.085***	-0.083***	-0.082**	-0.082**	-0.080**	-0.078**
(Inventory dev.)^2	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
(Lag Inv. Dev.)^2	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.008***
Order flow (corp.)	0.222***	0.222***	0.222***	0.222***	0.213***	0.214***	0.214***	0.214***
Order flow (priv.)	0.314***	0.315***	0.312***	0.313***	0.293***	0.294***	0.292***	0.292***
rho	-0.59	-0.59	-0.58	-0.59	-0.31	-0.32	-0.33	-0.32
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
OLS Estimates of Information and Bidder Participation								
U	-0.018	-0.013	-0.028**	-0.026*	-0.048*	-0.037	-0.050**	-0.053**
S	23.630***	21.715***	7.882**	10.473*	35.493***	34.903***	17.839***	20.254***
U*S	3.040***	2.854***	3.145***	3.544***	5.032***	4.620***	4.482***	5.387***
(U*S)^2	-0.590***	-0.555***	-0.464***	-0.626***	-1.013***	-0.941***	-0.712***	-0.988***
auc2	0.161	0.156	0.141	0.167	-0.569***	-0.574***	-0.604***	-0.559***
auc3	0.215	0.213	0.208	0.209	-0.906***	-0.907***	-0.915***	-0.916***
Order flow (corp.)	0.372***	0.397***	0.466***	0.444***	0.193*	0.220**	0.323***	0.282**
Order flow (priv.)	0.430***	0.444***	0.500***	0.442***	0.647**	0.662**	0.753**	0.653***
Derivative	2.71	2.55	2.85	3.15	4.47	4.10	4.03	4.76
R^2	0.25	0.25	0.24	0.25	0.30	0.31	0.28	0.31
F	95.0	97.0	62.5	71.0	31.6	31.9	21.7	31.4
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 8. Assessing Quantity-Based Performance Using *Amdev* for Volatility

Uncertainty (U):	wbank amdev				wbid amdev			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	-0.007	-0.001	-0.035*	-0.019	-0.065**	-0.053*	-0.085***	-0.076**
S	30.579***	28.583***	8.539*	16.409***	40.736***	40.066***	15.957***	23.184***
U*S	3.053***	2.826***	4.322***	3.957***	5.703***	5.170***	6.109***	6.563***
(U*S)^2	-0.795***	-0.740***	-0.861***	-0.927***	-1.490***	-1.365***	-1.241***	-1.573***
auc2	0.144	0.138	0.119	0.156	-0.657***	-0.663***	-0.688***	-0.630***
auc3	0.18	0.176	0.165	0.185	-0.940***	-0.945***	-0.967***	-0.928***
Order flow (corp.)	0.142**	0.166**	0.255***	0.214***	0.061	0.084	0.211**	0.157
Order flow (priv.)	0.106	0.118	0.178	0.124	0.432*	0.443*	0.543**	0.456**
Derivative	2.745	2.539	3.941	3.544	5.126	4.641	5.559	5.862
Underlying Selectivity Estimation								
Inventory dev.	0.166**	0.167**	0.169**	0.171**	0.136**	0.137**	0.140**	0.141**
Lag Inv. Dev.	-0.087***	-0.088***	-0.086***	-0.083***	-0.082**	-0.083**	-0.080**	-0.079**
(Inventory dev.)^2	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
(Lag Inv. Dev.)^2	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
Order flow (corp.)	0.222***	0.223***	0.222***	0.222***	0.214***	0.214***	0.214***	0.214***
Order flow (priv.)	0.316***	0.317***	0.312***	0.314***	0.295***	0.295***	0.292***	0.293***
rho	-0.59	-0.59	-0.58	-0.59	-0.33	-0.33	-0.33	-0.33
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
OLS Estimates of Information and Bidder Participation								
U	-0.009	-0.004	-0.032*	-0.021	-0.065*	-0.053	-0.083**	-0.074**
S	27.208***	25.272***	7.504*	12.919**	39.706***	38.985***	15.785***	23.027***
U*S	3.338***	3.103***	4.265***	4.259***	5.818***	5.284***	6.102***	6.532***
(U*S)^2	-0.843***	-0.786***	-0.843***	-0.993***	-1.515***	-1.389***	-1.244***	-1.553***
auc2	0.157	0.152	0.139	0.168	-0.627***	-0.633***	-0.658***	-0.608***
auc3	0.225	0.222	0.211	0.226	-0.928***	-0.932***	-0.954***	-0.929***
Order flow (corp.)	0.366***	0.391***	0.474***	0.443***	0.185*	0.210*	0.338***	0.280**
Order flow (priv.)	0.426***	0.440***	0.501***	0.442***	0.640**	0.654**	0.759**	0.655***
Derivative	3.01	2.80	3.89	3.82	5.23	4.75	5.55	5.84
R^2	0.25	0.25	0.24	0.25	0.30	0.30	0.27	0.30
F	92.7	91.9	71.2	55.7	26.3	28.0	18.9	27.0
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 9. Assessing Quantity-Based Performance Using *Cantvsd* for Volatility

Uncertainty (U):	wbank cantvsd				wbid cantvsd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	-0.006	-0.003	-0.018**	-0.008	-0.004	0.001	-0.011	-0.007
S	31.419***	29.691***	4.983	18.922***	36.350***	35.036***	9.257	20.331**
U*S	1.293***	1.162***	1.884***	1.475***	2.929***	2.764***	2.940***	3.128***
(U*S)^2	-0.150***	-0.135***	-0.156***	-0.152***	-0.331***	-0.317***	-0.249***	-0.323***
auc2	0.071	0.066	0.052	0.069	-0.673***	-0.676***	-0.692***	-0.666***
auc3	0.115	0.111	0.107	0.103	-0.951***	-0.954***	-0.966***	-0.964***
Order flow (corp.)	0.149**	0.172**	0.278***	0.219***	0.09	0.114	0.236**	0.179*
Order flow (priv.)	0.092	0.104	0.152	0.104	0.380*	0.389*	0.468**	0.386**
Derivative	1.143	1.026	1.711	1.302	2.597	2.446	2.664	2.761
Underlying Selectivity Estimation								
Inventory dev.	0.166**	0.167**	0.170**	0.172**	0.135**	0.136**	0.140**	0.140**
Lag Inv. Dev.	-0.088***	-0.088***	-0.087***	-0.085***	-0.082**	-0.082**	-0.080**	-0.079**
$(\text{Inventory dev.})^2$	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
$(\text{Lag Inv. Dev.})^2$	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
Order flow (corp.)	0.222***	0.222***	0.221***	0.222***	0.212***	0.213***	0.214***	0.213***
Order flow (priv.)	0.315***	0.315***	0.310***	0.313***	0.292***	0.293***	0.291***	0.291***
rho	-0.59	-0.60	-0.59	-0.60	-0.31	-0.32	-0.33	-0.32
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0	0	0	0
OLS Estimates of Information and Bidder Participation								
U	-0.008	-0.005	-0.018**	-0.01	-0.005	0	-0.011	-0.008
S	28.743***	27.111***	4.599	15.672***	35.568***	34.224***	9.225	19.835**
U*S	1.384***	1.248***	1.846***	1.588***	2.979***	2.811***	2.937***	3.172***
(U*S)^2	-0.159***	-0.145***	-0.155***	-0.165***	-0.337***	-0.322***	-0.249***	-0.328***
auc2	0.08	0.076	0.068	0.08	-0.647***	-0.650***	-0.665***	-0.641***
auc3	0.157	0.154	0.15	0.145	-0.943***	-0.946***	-0.956***	-0.960***
Order flow (corp.)	0.375***	0.399***	0.497***	0.454***	0.203**	0.230**	0.360***	0.295**
Order flow (priv.)	0.416***	0.431***	0.480***	0.428***	0.573**	0.588**	0.681**	0.571***
Derivative	1.22	1.10	1.67	1.40	2.64	2.49	2.66	2.80
R^2	0.25	0.25	0.23	0.24	0.32	0.32	0.29	0.32
F	151.4	104.1	142.4	80.9	40.6	36.6	31.5	38.8
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 10. Assessing Quantity-Based Performance Using *VBN3MCurncy* for Volatility

Uncertainty (U):	wbank vbn3mcurncy				wbid vbn3mcurncy			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	-0.004***	-0.004**	-0.003**	-0.005***	0.004	0.005*	0.009***	0.003
S	23.737**	21.971**	18.058**	9.46	18.532	17.491	29.934***	3.405
U*S	0.280***	0.268***	0.144***	0.367***	0.598***	0.579***	0.210***	0.713***
(U*S)^2	-0.006***	-0.006***	-0.002***	-0.007***	-0.011***	-0.011***	-0.003***	-0.013***
auc2	0.076	0.072	0.039	0.078	-0.700***	-0.702***	-0.748***	-0.686***
auc3	0.114	0.111	0.085	0.108	-0.965***	-0.966***	-0.999***	-0.957***
Order flow (corp.)	0.202***	0.226***	0.252***	0.248***	0.155**	0.181**	0.188*	0.213***
Order flow (priv.)	0.215	0.227	0.228*	0.183	0.497**	0.511**	0.508**	0.453***
Derivative	0.245	0.233	0.130	0.317	0.531	0.512	0.188	0.619
Underlying Selectivity Estimation								
Inventory dev.	0.164**	0.165**	0.171**	0.168**	0.132**	0.132**	0.138**	0.134**
Lag Inv. Dev.	-0.087***	-0.088***	-0.086***	-0.083***	-0.079**	-0.080**	-0.080**	-0.077**
$(\text{Inventory dev.})^2$	0.003	0.003	0.003	0.003	0.001	0.001	0.002	0.002
$(\text{Lag Inv. Dev.})^2$	0.009***	0.009***	0.009***	0.009***	0.008***	0.008***	0.009***	0.008***
Order flow (corp.)	0.219***	0.220***	0.222***	0.221***	0.211***	0.212***	0.215***	0.212***
Order flow (priv.)	0.306***	0.306***	0.311***	0.307***	0.289***	0.289***	0.294***	0.289***
rho	-0.57	-0.57	-0.58	-0.58	-0.26	-0.27	-0.34	-0.28
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0.001	0.001	0	0
OLS Estimates of Information and Bidder Participation								
U	-0.005***	-0.004***	-0.003**	-0.004***	0.004	0.005	0.009***	0.007**
S	19.374**	17.332*	18.506**	20.650***	17.137	16	30.401***	30.016**
U*S	0.321***	0.311***	0.132***	0.187***	0.617***	0.598***	0.207***	0.318**
(U*S)^2	-0.007***	-0.006***	-0.002***	-0.003***	-0.011***	-0.011***	-0.003***	-0.005**
auc2	0.084	0.08	0.052	0.078	-0.674***	-0.676***	-0.718***	-0.677***
auc3	0.149	0.147	0.126	0.142	-0.954***	-0.955***	-0.984***	-0.965***
Order flow (corp.)	0.419***	0.445***	0.473***	0.441***	0.252***	0.283***	0.317***	0.258**
Order flow (priv.)	0.530***	0.546***	0.562***	0.521***	0.660**	0.680**	0.726***	0.634**
Derivative	0.28	0.27	0.12	0.16	0.55	0.53	0.18	0.28
R^2	0.26	0.26	0.23	0.25	0.34	0.34	0.29	0.32
F	124.7	95.5	26.5	27.7	32.8	35.5	22.2	27.0
N	5266	5266	5266	5266	5266	5266	5266	5266

Notes: See notes on Table 3, page 24.

Table 11. Assessing Quantity-Based Performance Using *EMBI* for Volatility

Uncertainty (U):	wbank embi				wbid embi			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
				Heckit Estimates of Information and Bidder Participation				
U	-0.001	-0.001	0	0	0.008***	0.009***	0.012***	0.011***
S	50.440***	50.313**	74.249***	71.639***	-4.874	-4.811	94.003	86.371
U*S	0.059**	0.054	-0.034	0.013	0.224***	0.220***	-0.03	0.072
(U*S)^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.001***	-0.001***	-0.000***	-0.001***
auc2	0.134	0.125	0.068	0.111	-0.515***	-0.525***	-0.649***	-0.563***
auc3	0.153	0.146	0.083	0.125	-0.773***	-0.777***	-0.920***	-0.822***
Order flow (corp.)	0.194***	0.220***	0.210***	0.205***	0.174***	0.208***	0.112	0.139*
Order flow (priv.)	0.099	0.112	0.233	0.095	0.360*	0.367*	0.529**	0.339*
Derivative	0.040	0.035	-0.036	-0.002	0.183	0.179	-0.034	0.043
				Underlying Selectivity Estimation				
Inventory dev.	0.161**	0.162**	0.170**	0.166**	0.134**	0.135**	0.142**	0.137**
Lag Inv. Dev.	-0.078**	-0.079**	-0.074**	-0.073**	-0.069**	-0.071**	-0.072**	-0.069**
(Inventory dev.)^2	0.002	0.002	0.003	0.003	0.001	0.001	0.002	0.001
(Lag Inv. Dev.)^2	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***
Order flow (corp.)	0.231***	0.232***	0.238***	0.235***	0.220***	0.221***	0.228***	0.224***
Order flow (priv.)	0.311***	0.311***	0.318***	0.316***	0.289***	0.290***	0.301***	0.295***
rho	-0.60	-0.61	-0.61	-0.62	-0.21	-0.23	-0.40	-0.29
N	9549	9549	9549	9549	9549	9549	9549	9549
N_cens	4456	4456	4456	4456	4456	4456	4456	4456
Prob. (Chi^2)	0	0	0	0	0.017	0.007	0	0
				OLS Estimates of Information and Bidder Participation				
U	-0.001	0	0	0	0.008***	0.009***	0.012***	0.011***
S	60.303***	59.460**	89.718***	86.223***	-2.226	-1.901	102.641	86.595
U*S	0.052*	0.048	-0.053*	-0.001	0.224***	0.220**	-0.04	0.074
(U*S)^2	-0.001***	-0.001***	-0.000***	-0.000***	-0.001***	-0.001***	-0.000***	-0.001***
auc2	0.136	0.128	0.072	0.114	-0.514***	-0.524***	-0.645***	-0.561***
auc3	0.193	0.189	0.123	0.172	-0.764***	-0.768***	-0.908***	-0.811***
Order flow (corp.)	0.422***	0.452***	0.452***	0.444***	0.243***	0.287***	0.267**	0.239**
Order flow (priv.)	0.428***	0.446***	0.584***	0.440***	0.471**	0.494**	0.770***	0.497**
Derivative	0.03	0.03	-0.06	-0.02	0.18	0.18	-0.04	0.04
R^2	0.28	0.27	0.24	0.27	0.42	0.42	0.31	0.40
F	81.6	87.7	33.7	82.3	36.5	33.1	23.5	51.8
N	5108	5108	5108	5108	5108	5108	5108	5108

Notes: See notes on Table 3, page 24.

Table 12. Assessing Price-Based Performance Using *Spread* for Volatility

	prem				clpr			
Uncertainty (U):	spread				spread			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	23.583***	23.366***	22.463***	23.452***	20.619***	20.445***	19.667***	20.543***
S	2110.391***	2168.808***	709.642	1836.228***	1845.969**	1905.274***	622.267	1615.913***
U*S	-203.194***	-208.699***	-98.298***	-189.021***	-180.665***	-186.080***	-88.081***	-168.909***
(U*S)^2	18.482***	18.815***	7.194***	15.658***	16.687***	16.960***	6.534***	14.097***
auc2	6.323	6.583	4.67	5.396	-15.779	-15.58	-17.233	-16.686
auc3	41.847*	41.146*	44.305*	39.798*	26.723	26.075	28.942	24.876
Order flow (corp.)	-0.805	-0.719	3.830*	0.718	-0.382	-0.274	3.719**	1.035
Order flow (priv.)	-2.852	-1.146	-1.58	1.467	0.527	2.134	1.746	4.533
Derivative	-187.177	-192.388	-91.157	-173.303	-166.204	-171.377	-81.595	-154.757
Underlying Selectivity Estimation								
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.216***	0.216***	0.215***	0.216***	0.216***	0.216***	0.215***	0.216***
rho	-0.09	-0.09	-0.08	-0.09	-0.09	-0.09	-0.08	-0.09
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.007	0.006	0.029	0.006	0.006	0.005	0.026	0.006
OLS Estimates of Information and Bidder Participation								
U	23.522***	23.308***	22.408***	23.435***	20.569***	20.397***	19.622***	20.531***
S	2120.661***	2177.297***	706.46	1738.293***	1856.249**	1913.845***	619.75	1528.681**
U*S	-201.258***	-206.961***	-96.916***	-182.657***	-179.006***	-184.587***	-86.867**	-163.214***
(U*S)^2	18.352***	18.706***	7.127***	14.764***	16.574***	16.866***	6.475***	13.295***
auc2	7.066	7.316	5.364	6.408	-14.976	-14.784	-16.477	-15.631
auc3	42.499*	41.782*	44.883*	41.241*	27.321	26.66	29.473	26.192
Order flow (corp.)	2.368	2.432	6.794***	4.751*	2.51	2.6	6.451***	4.708**
Order flow (priv.)	1.053	2.703	1.963	4.89	4.098	5.658	5.028	7.678
Derivative	-185.36	-190.74	-89.84	-167.84	-164.64	-169.97	-80.44	-149.87
R^2	0.46	0.46	0.44	0.46	0.43	0.44	0.42	0.43
F	77.0	85.8	61.2	69.4	74.1	82.7	42.9	66.9
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: The upper panel in Table 12 shows estimation with selectivity, and the lower panel shows estimation with OLS. For each estimation, the left panel shows estimates using prem (as the left-hand-side variable) – the premium paid over the clearing price, and the right panel shows estimates using clpr -- the premium paid over the minimum weighted bid in the auction. The uncertainty and sophistication measures are reported across the top of the table, and the results are reported in the row labeled "U" and "S" respectively. "S," bank sophistication based on market share, is given by: banksize (average retail sales), bksize (average retail sales and purchases), lbsize (previous days retail customer sales), bsizema5 (five-day moving average of retail sales). The rows labeled "S*U" and "S*U^2" report the interaction and squared interaction terms, respectively, and "auc2" and "auc3" report indicator variables for the second and third auctions of the day. The selection equation uses the deviation from the average inventory over the past five days, the order flow from corporate and non-corporate customers. Statistics are reported in the bottom panel.

Table 13. Assessing Price-Based Performance Using *Sprd* for Volatility

Uncertainty (U):	prem sprd				clpr sprd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	27.966***	27.798***	26.744***	27.984***	24.801***	24.670***	23.739***	24.853***
S	1892.487***	1994.851***	682.943*	1721.717***	1694.510***	1792.874***	613.717*	1545.405***
U*S	-227.438***	-240.808***	-112.394***	-222.010***	-206.955***	-219.522***	-102.863***	-202.155***
(U*S)^2	24.643***	26.061***	9.585***	21.957***	22.792***	24.024***	8.906***	20.164***
auc2	2.655	3.176	-0.72	1.804	-18.232	-17.795	-21.313	-19.1
auc3	17.384	17.114	17.684	15.472	5.452	5.183	5.72	3.683
Order flow (corp.)	-0.754	-0.792	3.254	0.489	-0.353	-0.349	3.258*	0.838
Order flow (priv.)	-2.258	-1.005	-0.034	1.677	1.018	2.246	3.104	4.734
Derivative	-210.403	-222.788	-104.832	-204.475	-191.200	-202.910	-95.838	-186.052
Underlying Selectivity Estimation								
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.032	-0.031	-0.031	-0.031	-0.031	-0.031
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.216***	0.216***	0.215***	0.215***	0.216***	0.216***	0.215***	0.216***
rho	-0.09	-0.09	-0.08	-0.09	-0.09	-0.09	-0.08	-0.09
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.009	0.007	0.028	0.007	0.009	0.006	0.027	0.007
OLS Estimates of Information and Bidder Participation								
U	27.837***	27.673***	26.628***	27.861***	24.692***	24.563***	23.640***	24.746***
S	1896.201**	1996.758***	675.983*	1520.885**	1698.800**	1795.429***	607.800*	1362.344**
U*S	-224.484***	-238.035***	-110.310**	-201.073***	-204.397***	-217.120***	-101.030**	-183.060***
(U*S)^2	24.434***	25.876***	9.480***	18.784***	22.611***	23.864***	8.813***	17.264***
auc2	3.593	4.104	0.186	2.766	-17.256	-16.827	-20.369	-18.081
auc3	18.384	18.099	18.616	17.62	6.362	6.08	6.569	5.656
Order flow (corp.)	2.482	2.467	6.233**	5.031*	2.596	2.617	6.000***	4.979*
Order flow (priv.)	1.591	2.851	3.39	4.833	4.54	5.769	6.274	7.607
Derivative	-207.59	-220.14	-102.83	-186.07	-188.77	-200.62	-94.08	-169.27
R^2	0.44	0.45	0.43	0.44	0.43	0.44	0.42	0.43
F	103.1	96.7	117.8	60.8	92.5	81.8	84.7	50.5
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 14. Assessing Price-Based Performance Using *Sd* for Volatility

	prem				clpr			
Uncertainty (U):	sd				sd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
	Heckit Estimates of Information and Bidder Participation							
U	97.751***	97.195***	92.615***	98.119***	86.319***	85.893***	81.861***	86.799***
S	1997.419***	2134.953***	719.592*	1918.061***	1769.685***	1899.686***	639.908*	1709.205***
U*S	-900.503***	-962.890***	-464.359***	-929.984***	-810.451***	-868.661***	-420.131***	-839.592***
(U*S)^2	375.129***	402.578***	162.182***	364.148***	342.230***	366.573***	148.402***	330.777***
auc2	17.338	18.001	14.999	16.663	-5.525	-4.961	-7.63	-6.221
auc3	20.385	20.333	20.705	18.072	8.102	8.032	8.387	5.981
Order flow (corp.)	-0.62	-0.796	3.453	0.351	-0.219	-0.342	3.414*	0.716
Order flow (priv.)	-0.814	0.414	1.421	3.645	2.316	3.5	4.386	6.467
Derivative	-824.238	-881.018	-426.825	-844.726	-740.874	-794.111	-385.786	-762.147
	Underlying Selectivity Estimation							
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.215***	0.216***	0.215***	0.215***	0.216***	0.216***	0.215***	0.215***
rho	-0.09	-0.09	-0.08	-0.09	-0.09	-0.09	-0.08	-0.09
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.011	0.008	0.03	0.006	0.01	0.008	0.029	0.006
	OLS Estimates of Information and Bidder Participation							
U	97.305***	96.761***	92.221***	96.705***	85.937***	85.522***	81.522***	85.532***
S	1998.054***	2133.972***	711.898*	1532.482**	1771.203***	1899.651***	633.312*	1360.090**
U*S	-889.199***	-952.264***	-456.663***	-758.705***	-800.624***	-859.419***	-413.349***	-684.355***
(U*S)^2	371.989***	399.758***	160.622***	276.599***	339.502***	364.127***	147.025***	251.385***
auc2	18.477	19.126	16.106	18.253	-4.371	-3.819	-6.509	-4.643
auc3	21.501	21.432	21.755	21.256	9.111	9.026	9.336	8.876
Order flow (corp.)	2.497	2.354	6.279***	5.074*	2.625	2.532	6.020***	5.016**
Order flow (priv.)	2.879	4.13	4.654	5.564	5.704	6.906	7.388	8.235
Derivative	-813.57	-870.97	-419.49	-693.95	-731.60	-785.37	-379.32	-625.50
R^2	0.40	0.41	0.39	0.40	0.39	0.39	0.37	0.39
F	74.4	76.7	91.8	49.9	70.9	68.2	70.1	44.3
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 15. Assessing Price-Based Performance Using *Asprd* for Volatility

Uncertainty (U):			prem asprd				clpr asprd	
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
			Heckit Estimates of Information and Bidder Participation					
U	4.160***	4.123***	4.210***	4.246***	3.480***	3.458***	3.548***	3.570***
S	-311.841	-370.638	-205.194	-220.049	-322.371	-365.694	-183.581	-232.208
U*S	1.991	4.447	1.134	-1.728	3.264	5.043	1.302	-0.342
(U*S)^2	0.084	-0.023	0.029	0.158	0.018	-0.068	0.011	0.08
auc2	-25.223	-24.92	-25.063	-26.041	-44.064**	-43.864**	-44.013**	-44.884***
auc3	48.430*	48.574*	48.393*	48.207*	31.629	31.722	31.576	31.377
Order flow (corp.)	-0.052	-0.017	-0.217	0.38	0.291	0.362	0.07	0.76
Order flow (priv.)	-9.313	-9.322	-9.259	-8.602	-5	-4.954	-4.936	-4.301
Derivative	2.189	4.393	1.213	-1.298	3.305	4.883	1.331	-0.123
			Underlying Selectivity Estimation					
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***
rho	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.065	0.071	0.087	0.055	0.064	0.068	0.085	0.054
			OLS Estimates of Information and Bidder Participation					
U	4.152***	4.116***	4.204***	4.221***	3.474***	3.453***	3.544***	3.551***
S	-306.101	-367.136	-203.722	-274.062	-316.249	-361.719	-181.929	-273.616
U*S	2.671	5.104	1.573	0.936	3.866	5.631	1.697	1.8
(U*S)^2	0.055	-0.051	0.015	0.025	-0.008	-0.093	-0.002	-0.026
auc2	-24.344	-24.054	-24.266	-25.045	-43.147**	-42.957**	-43.171**	-43.909**
auc3	48.664	48.797	48.61	48.495	31.857	31.941	31.79	31.634
Order flow (corp.)	2.115	2.128	1.957	2.817	2.321	2.383	2.12	3.022
Order flow (priv.)	-6.601	-6.651	-6.566	-5.719	-2.449	-2.426	-2.387	-1.566
Derivative	2.80	4.98	1.61	1.00	3.85	5.41	1.69	1.73
R^2	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06
F	88.4	78.0	48.5	45.4	77.6	61.9	41.0	40.3
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 16. Assessing Price-Based Performance Using *Asd* for Volatility

Uncertainty (U):	prem asd				clpr asd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
			Heckit Estimates of Information and Bidder Participation					
U	25.072***	24.945***	24.262***	25.499***	21.102***	21.035***	20.535***	21.532***
S	271.16	284.094	-189.703	376.686	169.358	185.348	-168.598	267.399
U*S	-87.456	-89.121	-27.365	-116.464*	-67.023	-69.282	-21.257	-92.259
(U*S)^2	20.835*	21.398**	7.631	25.013***	16.621*	17.066*	6.074	19.816**
auc2	-6.359	-6.411	-5.073	-7.361	-28.005*	-28.092*	-26.980*	-28.937*
auc3	62.417**	62.392**	63.225**	61.981**	43.635*	43.591*	44.269*	43.239*
Order flow (corp.)	-0.403	-0.506	1.136	-0.011	-0.006	-0.046	1.198	0.439
Order flow (priv.)	-9.151	-9.202	-8.867	-7.84	-4.913	-4.898	-4.64	-3.71
Derivative	-75.964	-77.314	-22.560	-100.582	-57.855	-59.866	-17.432	-79.678
			Underlying Selectivity Estimation					
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***
rho	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.111	0.115	0.123	0.085	0.105	0.107	0.119	0.081
			OLS Estimates of Information and Bidder Participation					
U	25.031***	24.907***	24.231***	25.230***	21.071***	21.006***	20.511***	21.316***
S	274.86	285.895	-190.082	233.174	173.682	187.852	-168.68	151.132
U*S	-84.825	-86.554	-25.515	-89.992	-64.693	-66.994	-19.575	-70.494
(U*S)^2	20.400*	20.974*	7.383	19.089**	16.231	16.684*	5.845	14.954*
auc2	-5.443	-5.507	-4.229	-5.619	-27.055	-27.153	-26.096	-27.336
auc3	62.820**	62.785**	63.588**	63.120**	44.007*	43.955*	44.607*	44.200*
Order flow (corp.)	1.638	1.544	3.136	2.628	1.917	1.893	3.097*	2.865
Order flow (priv.)	-6.593	-6.641	-6.386	-5.443	-2.492	-2.465	-2.275	-1.384
Derivative	-73.57	-74.98	-20.87	-77.87	-55.74	-57.79	-15.90	-61.00
R^2	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10
F	73.3	76.7	77.7	84.0	59.5	60.0	57.3	63.1
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 17. Assessing Price-Based Performance Using *Amdev* for Volatility

Uncertainty (U):	prem amdev				clpr amdev			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
			Heckit Estimates of Information and Bidder Participation					
U	36.347***	36.262***	35.824***	36.901***	31.057***	31.036***	30.668***	31.643***
S	42.918	63.688	-204.194	186.513	10.976	37.932	-190.686	148.944
U*S	-72.832	-75.632	-28.237	-113.038	-62.216	-66.684	-24.175	-100.297
(U*S)^2	27.58	28.441	13.296	36.274**	24.745	25.685	11.805	32.324**
auc2	15.723	15.798	16.664	15.076	-8.832	-8.816	-7.984	-9.501
auc3	74.175***	74.217***	75.233***	73.707**	54.033**	54.035**	54.976**	53.578**
Order flow (corp.)	0.875	0.779	1.807	0.941	1.044	0.991	1.865	1.19
Order flow (priv.)	-8.63	-8.595	-8.417	-7.703	-4.528	-4.439	-4.289	-3.585
Derivative	-62.149	-64.612	-22.353	-96.874	-52.631	-56.731	-18.950	-85.894
			Underlying Selectivity Estimation					
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***
rho	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.234	0.24	0.231	0.202	0.201	0.204	0.202	0.171
			OLS Estimates of Information and Bidder Participation					
U	36.314***	36.231***	35.791***	36.695***	31.035***	31.015***	30.646***	31.466***
S	48.329	67.686	-205.237	89.533	16.977	42.544	-191.397	63.652
U*S	-70.634	-73.528	-26.246	-89.396	-60.266	-64.802	-22.341	-79.227
(U*S)^2	27.16	28.046	12.969	28.865*	24.365	25.326	11.498	25.721*
auc2	16.546	16.61	17.436	16.302	-7.957	-7.95	-7.157	-8.266
auc3	74.602**	74.635**	75.627**	74.706**	54.432**	54.427**	55.345**	54.490**
Order flow (corp.)	2.487	2.391	3.442**	3.038*	2.613	2.569	3.461**	3.202**
Order flow (priv.)	-6.66	-6.633	-6.445	-5.78	-2.592	-2.499	-2.346	-1.672
Derivative	-60.11	-62.66	-20.51	-76.53	-50.83	-54.99	-17.25	-67.77
R^2	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12
F	68.3	70.0	61.3	65.3	55.3	55.8	45.3	49.8
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 18. Assessing Price-Based Performance Using *Cantvsd* for Volatility

Uncertainty (U):	prem cantvsd				clpr cantvsd			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
Heckit Estimates of Information and Bidder Participation								
U	7.291***	7.106***	6.964***	7.125***	5.957***	5.809***	5.695***	5.843***
S	286.542	215.694	41.51	100.831	222.263	164.591	22.687	70.526
U*S	-39.08	-34.756	-15.613	-32.298	-33.58	-30.515	-14.137	-29.467
(U*S)^2	3.615	3.586	0.994	3.07	3.257	3.286	1.008	2.916
auc2	-55.948***	-55.779***	-55.611***	-56.481***	-70.141***	-70.042***	-69.873***	-70.747***
auc3	9.871	9.974	10.201	9.841	-0.974	-0.909	-0.721	-1.06
Order flow (corp.)	-0.298	-0.477	0.115	0.408	0.017	-0.102	0.404	0.727
Order flow (priv.)	-8.6	-8.9	-8.942	-8.145	-4.239	-4.448	-4.442	-3.69
Derivative	-35.453	-31.156	-14.510	-28.811	-30.312	-27.216	-13.019	-26.156
Underlying Selectivity Estimation								
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
$(\text{Inventory dev.})^2$	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
$(\text{Lag Inv. Dev.})^2$	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***
rho	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.008	0.009	0.015	0.007	0.009	0.011	0.017	0.008
OLS Estimates of Information and Bidder Participation								
U	7.274***	7.093***	6.949***	7.102***	5.942***	5.797***	5.681***	5.823***
S	301.336	228.152	41.325	89.43	235.745	175.952	22.425	59.991
U*S	-37.281	-33.06	-14.277	-30.033	-31.937	-28.96	-12.913	-27.375
(U*S)^2	3.416	3.397	0.886	2.831	3.075	3.112	0.908	2.696
auc2	-55.166***	-55.016***	-54.920***	-55.817***	-69.315***	-69.233***	-69.131***	-70.026***
auc3	9.992	10.081	10.276	9.913	-0.851	-0.799	-0.64	-0.98
Order flow (corp.)	2.372	2.192	2.737	3.255	2.504	2.392	2.856	3.390*
Order flow (priv.)	-5.215	-5.535	-5.701	-4.669	-1.078	-1.296	-1.402	-0.427
Derivative	-33.85	-29.65	-13.29	-26.82	-28.85	-25.84	-11.91	-24.31
R^2	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
F	18.1	18.4	15.4	17.8	13.4	13.8	12.0	15.4
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 19. Assessing Price-Based Performance Using *VBN3MCurncy* for Volatility

Uncertainty (U):	prem vbn3mcurncy				clpr vbn3mcurncy			
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
			Heckit Estimates of Information and Bidder Participation					
U	0.473**	0.464**	0.600***	0.499**	0.406**	0.400**	0.536***	0.434**
S	-977.011	-1062.087	-239.225	-811.712	-994.988	-1075.704	-238.442	-813.147
U*S	8.939	10.057	1.259	6.877	9.286	10.263	1.307	7.068
(U*S)^2	-0.118	-0.135	-0.008	-0.091	-0.123	-0.138	-0.007	-0.093
auc2	-52.155***	-52.045***	-52.768***	-53.158***	-66.869***	-66.827***	-67.541***	-67.864***
auc3	14.408	14.456	14.107	14.23	2.962	2.979	2.621	2.775
Order flow (corp.)	0.463	0.524	-0.832	0.575	0.846	0.963	-0.475	0.903
Order flow (priv.)	-7.725	-7.733	-8.277	-7.921	-3.945	-3.906	-4.527	-4.189
Derivative	8.206	9.219	1.203	6.222	8.525	9.409	1.257	6.399
			Underlying Selectivity Estimation					
Inventory dev.	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*	0.128*
Lag Inv. Dev.	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
$(\text{Inventory dev.})^2$	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
$(\text{Lag Inv. Dev.})^2$	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***	0.186***
Order flow (priv.)	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***	0.215***
rho	-0.05	-0.05	-0.06	-0.05	-0.05	-0.05	-0.06	-0.05
N	9697	9697	9697	9697	9697	9697	9697	9697
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.055	0.06	0.036	0.029	0.068	0.073	0.04	0.036
			OLS Estimates of Information and Bidder Participation					
U	0.417*	0.410**	0.550***	0.478**	0.359*	0.355*	0.495***	0.423**
S	-1053.845	-1139.05	-270.048	-712.634	-1056.543	-1137.907	-262.835	-698.768
U*S	10.005	11.089	1.722	5.366	10.176	11.128	1.699	5.356
(U*S)^2	-0.13	-0.146	-0.01	-0.057	-0.133	-0.147	-0.009	-0.057
auc2	-51.333**	-51.253**	-52.057**	-53.128**	-66.003***	-65.988***	-66.775***	-67.782***
auc3	14.472	14.499	14.126	13.958	3.046	3.044	2.662	2.512
Order flow (corp.)	2.65	2.68	1.705	2.813	2.828	2.925	1.888	2.931
Order flow (priv.)	-5.232	-5.292	-5.253	-4.866	-1.673	-1.669	-1.698	-1.374
Derivative	9.20	10.18	1.65	4.95	9.35	10.21	1.64	4.95
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	13.1	13.1	8.3	8.7	13.9	13.3	10.5	10.2
N	3258	3258	3258	3258	3258	3258	3258	3258

Notes: See Table 12 on page 33.

Table 20. Assessing Price-Based Performance Using *EMBI* for Volatility

Uncertainty (U):			prem embi				clpr embi	
Sophistication (S):	banksize	bksize	lbsize	bsizema5	banksize	bksize	lbsize	bsizema5
			Heckit Estimates of Information and Bidder Participation					
U	1.503***	1.471***	1.494***	1.468***	1.307***	1.279***	1.299***	1.277***
S	1130.686	426.12	664.835	-57.077	1145.31	565.41	736.835	121.341
U*S	-2.518	-1.822	-0.84	-0.617	-2.382	-1.835	-0.918	-0.761
(U*S)^2	0.009*	0.010*	0	0.003	0.008*	0.008*	0	0.003
auc2	-51.105**	-51.083**	-48.594**	-50.087**	-66.162***	-66.216***	-64.008***	-65.381***
auc3	15.695	15.729	17.67	16.882	3.944	3.933	5.653	4.94
Order flow (corp.)	-4.165	-4.57	-2.508	-2.124	-3.25	-3.555	-1.748	-1.342
Order flow (priv.)	-11.991	-12.496	-11.634	-11.239	-7.382	-7.775	-7.065	-6.64
Derivative	-2.182	-1.458	-0.839	-0.486	-2.086	-1.512	-0.916	-0.643
			Underlying Selectivity Estimation					
Inventory dev.	0.130**	0.130**	0.130**	0.130**	0.131**	0.131**	0.130**	0.131**
Lag Inv. Dev.	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025
(Inventory dev.)^2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(Lag Inv. Dev.)^2	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Order flow (corp.)	0.194***	0.194***	0.194***	0.194***	0.194***	0.194***	0.194***	0.194***
Order flow (priv.)	0.214***	0.214***	0.214***	0.214***	0.214***	0.214***	0.214***	0.214***
rho	-0.07	-0.07	-0.06	-0.06	-0.07	-0.07	-0.06	-0.06
N	9614	9614	9614	9614	9614	9614	9614	9614
N_cens	6453	6453	6453	6453	6453	6453	6453	6453
Prob. (Chi^2)	0.012	0.012	0.075	0.024	0.015	0.015	0.078	0.027
			OLS Estimates of Information and Bidder Participation					
U	1.464***	1.432***	1.457***	1.433***	1.273***	1.246***	1.268***	1.247***
S	857.412	157.369	498.41	-184.204	912.528	335.798	600.259	17.308
U*S	-2.021	-1.335	-0.615	-0.379	-1.947	-1.407	-0.729	-0.555
(U*S)^2	0.008	0.008	0	0.003	0.007	0.008	0	0.002
auc2	-50.515**	-50.534**	-48.377**	-49.795**	-65.573***	-65.664***	-63.762***	-65.061***
auc3	15.984	15.995	17.71	16.965	4.241	4.209	5.721	5.051
Order flow (corp.)	-1.166	-1.501	0.068	0.788	-0.481	-0.712	0.66	1.369
Order flow (priv.)	-8.433	-8.873	-8.501	-7.78	-4.072	-4.394	-4.11	-3.395
Derivative	-1.72	-1.01	-0.62	-0.27	-1.69	-1.12	-0.73	-0.45
R^2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
F	7.4	7.3	11.0	6.9	8.0	7.6	10.8	7.0
N	3170	3170	3170	3170	3170	3170	3170	3170

Notes: See Table 12 on page 33.

Table 21. Estimates of Impact of Ten Percent Market Share

	wbank		wbid		prem		clpr	
	mean	sd	mean	sd	mean	sd	mean	sd
spread	1.0	0.9	2.2	2.1	2.0	1.9	1.9	1.8
sprd	1.1	1.0	2.0	1.9	1.9	1.8	1.8	1.8
sd	1.5	1.4	2.8	2.5	2.0	1.9	1.9	1.8
asprd	3.0	1.9	4.8	3.1	0.4	0.3	0.4	0.4
asd	3.0	1.9	5.3	3.4	1.0	0.8	0.9	0.7
amdev	2.4	1.6	4.4	3.0	0.8	0.6	0.7	0.6
cantvxr	2.8	1.9	6.3	4.3	1.0	0.8	0.9	0.7
vbn3mcurncy	3.7	1.8	8.0	3.9	1.2	0.8	1.2	0.8
embi	3.7	0.3	16.9	1.3	1.5	0.4	1.5	0.4

Notes: The table shows the approximate impact on bidding and prices paid for a bank that controls 10 percent of the retail market, as measured by “banksize,” and are calculated using the average value of the volatility measure in the left column for the sample period. The impact on bidding and winning is expressed in percent of the amount auctioned off and is observed in the columns labeled wbid and wbank respectively. The impact on prices is expressed as a percent of the observed average exchange rate of 950 Bolivares per US dollar for the sample period and is shown for each volatility measure in the columns labeled prem and clpr. For each measure, the column labeled “mean” expresses the impact for the average observed value of the volatility shock, and the column labeled “sd” expresses the incremental impact for one standard deviation of the volatility measure.

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