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Competition on MARS? A Study of Broker-Dealer Competition in the U.S. Municipal Auction Rate Securities Market

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Abstract
The relationship between competitive bidding in auctions and its impact on price and interest rates has long been of importance for a wide range of market practitioners. Although research has shown that increased competition among broker-dealers and bidders results in lower municipal interest rates, the amount of literature addressing *auction* rate securities is almost non-existent. The U.S. municipal auction rate securities market (MARS) offers an opportunity to expand the growing but limited empirical analysis of auctions. In particular, researchers can study the impact of market power and competitive search on interest rates using this uniform pricing, multi-unit, frequently repeated dutch auction process. Furthermore, in general, previous cross-sectional models measuring relationships in standard municipal markets are quite static in that they mostly assume some form of dynamic parametric homogeneity. Using a novel empirical approach, i.e., one that doesn't assume the time-constancy of cross-sectional parameters, our research shows that greater underwriter competition and search for potential investors in the form of multiple broker-dealers does indeed lead to lower municipal auction rates**.** This outcome does not hold for the entire sample life of the security--a result that was captured clearly using our methodology.

JEL Codes: G12, G14, C23

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1. Introduction

Auction theory tells us that greater competition among bidders in securities markets should lead to higher prices and lower interest rates. The U.S. municipal auction rate securities (MARS) market offers a unique opportunity to empirically study the impact of market power and competitive search on interest rates reset using a uniform pricing, multi-unit frequently repeated dutch auction process.

U.S. municipal auction rate securities

As of the end of 2007, approximately $2.4 trillion of municipal securities were outstanding with approximately $325 billion represented by auction rate preferred stock and MARS.[1] MARS are long-term securities with interest rates reset periodically through a dutch auction mechanism giving them the characteristics of variable rate securities. A very limited non-auction secondary market is typically maintained for each security outstanding and supported by each broker-dealer's (BDs) inventory. The broker-dealer function for the MARS market is dominated by the largest investment banking firms. Municipal, non-profit, and corporate issuers typically hire a single firm to act as BD on most of their MARS transactions. However, some issuers of MARS prefer to use multiple BDs in the auction bidding process to improve liquidity and broaden marketability.[2]

MARS official offering statements describe a rate-setting process similar to a uniform-price, multi-unit auction that is repeated typically every 7, 28 or 35 days. Successful bidders receive the

[1] Sirri, Erik R., Testimony Concerning Municipal Bond Turmoil: Impact on Cities, Towns and States, US Securities and Exchange Commission, March 12, 2008.

[2] Fichera, Joseph S., Making Matters Worse: The Dangers of Auction Rate Securities, Saber Partners ,LLC, Op-Ed, 1991, modified 2004.

same price (rate) regardless of the bids they made. Prior to each auction, the BD establishes 'price talk' and canvasses current owners to determine whether they intend to sell or hold, and potential investors for their interest in placing bid orders. When BDs use price talk that may have been mutually developed between BDs to inform owners and prospective bidders, some of the pricing uncertainty among investors and other BDs is removed, perhaps narrowing the dispersion of bids. At each auction, current or potential investors submit 1 of 3 types of orders through the BD: 1) a hold order indicating willingness to own securities regardless of the rate resulting from the auction, 2) a sell order regardless of the rate at the auction, or 3) a bid order indicating a willingness to retain or buy securities at a specified rate level.

In practice, once orders are submitted to the BD, the BD may then submit one or more bids for its own account, and generally will particularly if insufficient bids have been submitted to establish a clearing rate. A single BD has complete information to manage auction risk since all bids are submitted through the BD. This allows the BD to set the market clearing rate as needed. All orders are then submitted by the BD to the auction agent hired by the issuer to compute the auction reset rate. The auction agent allocates available securities to the highest bid first (lowest rate) , and so on down the ranked sequence of bids received according to the quantity demanded until all securities have been allocated. If there are insufficient bids to clear the market, a failed auction results. The auction agent then resets the rate at the maximum rate using security-specific predetermined formula designed to compensate investors seeking liquidity in a failed auction at a substantial premium to market rates. In the event all orders are to hold securities, a very low all-hold rate is established in a similar fashion at a deep discount to market rates.

Issuers prefer the lowest market interest rates possible. Sellers demand liquidity at par while investors purchasing MARS prefer higher reset rates. Broker-dealers desire market-based reset rates to reduce inventory risk because they are providing implicit liquidity and have perhaps accumulated significant inventory beyond their desired level. For single BD transactions, these conflicts of interest present agency problems that may prevent proper price (interest rate) discovery at auction and increase costs to investors and issuers.

MARS and Auction Theory

The vast majority of research on municipal bonds sold in competitive auctions suggests that increasing underwriter search in the form of the number of bidders and dispersion of interest rates that are bid lead to lower interest rates, ceteris paribus. Brannman et al. [1987] examined the theoretical and empirical relationships between price and the number of bidders in a variety of first-price sealed-bid auction markets. They found a highly significant positive effect of the number of bidders on buying price. Back and Zender [2001] show that there is a competitive benefit to increasing the number of bidders in multi-unit uniform price auctions with supply adjustments of the quantity sold after the issuer reviews all bids. Kessel [1971] found that greater underwriter competition (search) represented by the number of bids submitted leads to lower municipal interest rates. Benson [1979] shows that an increase both in search intensity measured by the variance of interest rates bid by a syndicate of underwriters and in the number of bidders leads to the discovery of higher prices and lower municipal interest rates. Leonard [1995b] in a review of the literature on negotiated versus competitive initial sale of municipal and corporate securities, presented summary results similar to Benson's regarding the impact of competitive bidding intensity and underwriter search on interest rates. Simonson and Robbins [1996] show that relative to negotiated bid rates, there is no significant difference in interest rates when one to three bids were received on competitive sales. However, 4-5 bids or more produced significant interest rate savings, consistent with previous research and economic theory. And finally, Robbins, Simonson and Rocco [2004] study competitive open auctions where bidders know their relative bid ranking and find that such auctions of municipal bonds lead to significantly lower rates but that cost savings are dependent on increased competition (including increase in the number of bidding events) generated by this auction technique.

MARS dutch auctions are uniform price, multi-unit and common values auctions with orders for securities flowing through the BD(s) managing the auction. In MARS auctions one or more broker-dealers hired by the issuer may submit bids for their own account to supplement investor demand, thusly establishing the equilibrium clearing rate and providing liquidity as part of its implicit market-making activities, often to keep an auction from failing. For multiple-units of securities, awards are made in order of ascending rate (descending price) but a uniform price which just clears the amount offered is paid by all bidders. In common value auctions each bidder has some private information regarding the value of a security. But because of lack of an active secondary market, not enough information is made available to be certain about the true market value. And because each BD and bidder has only an estimate of the true value, he/she is interested in obtaining as much information as possible regarding the estimates of other bidders including other BDs. This may lead to tacit collusion or at a minimum information sharing between BDs [Chari and Weber, 1992].

Hence, *our study differs from those just cited in the following way*. The provision of liquidity during an auction by BDs is a direct result of the structure of the MARS auction design and is extremely valuable to the issuer of long-term securities having adjustable rates. BD demand adjustments of the quantity of investor orders prior to an auction rate being set tend to ensure the establishment of a market clearing rate. In such managed auctions the BD plays a vital and unique role in influencing the auction process, *unlike competition typical of the studies cited here*. Therefore, it is interesting to test whether the basic principals of competition also apply to the MARS market.

In a relationship-driven securities issuance market it is natural for an issuer to use the BD that best knows the company (that is, the lead securities underwriter) to be the primary market maker or broker-dealer for MARS. However, using only a single BD may create a conflict of interest and be costly to the Issuer. Broker-dealers are incentivized by a hefty but standard 25 basis point (bp) annual fee to keep as much of a bond issue as possible in their control. This conflict of interest between the BD's desire to maximize fee income and the issuer's desire for the lowest interest rate typically results in a single firm performing the role of BD and may lead to effectively higher rates given the market power of a single BD compared to multiple BDs.

Since a BD firm's profits relating to a MARS bond are greater with fewer BD competitors, it is worth more to a single BD to prevent the entry of an additional firm on the broker-dealer team. Auction theory indicates in a common values setting a positive relationship between the expected dispersion of bids and bid shading, [3] given a fixed number of bidders as in a MARS transaction and a direct relationship between uncertainty regarding the common value and dispersion of bids [Malvey et al, 1995; Wilson, 1977]. The greater the intensity of bidding competition, the smaller the dispersion of bids. *That is, more bidders lead to smaller dispersion of bids, less uncertainty of the common value, less bid shading and higher prices / lower rates*.

In multiple-BD auctions, broker-dealers effectively broaden the search for potential investors in the issuer's security in an attempt to gain control of more of the issuer's securities and increase fee income. While it is important for BDs not to significantly overbid and risk a loss

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[3] bid shading is the practice of a bidder bidding less (lower price/ higher rate) than what the bidder estimates the good is worth and is commonly used to compensate for the winner's curse.

from the sale of securities out of inventory, the negative impact of the winners curse is somewhat offset by the BD's ability to re-offer securities at a discount to increase yield to their investors. Although such discounting may result in the sacrifice of a portion of their fee, the BD retains control of the securities and provides the issuer with a lower interest rate.

Klemperer [2002] suggests that auction design may not matter very much when there are large numbers of potential bidders with easy access to an auction. Issuers of auction rate securities using one or two BDs as their agents in developing successful uniform price multi-unit repeated auctions are vulnerable to collusion because the repeated interaction among bidders allows them to learn to cooperate and exercise their market power. The resulting oligopolistic bidding may lead to BDs exploiting the auction mechanism with a result of pricing inefficiencies [Bower and Bunn, 2001]. Rothkopf [1999] highlights the role of repetition in electricity auctions, stating that tacit collusion is a much greater problem when bidders meet repeatedly as in MARS auctions, regardless of auction method. The probability that collusion (tacit or otherwise) should become more difficult as number of bidders increase reinforces the tendency for prices to rise (rates to fall) as the number of buyers increase. Klemperer suggests that what matters most in creating successful auctions are the same issues any industry regulator would recognize as central concerns: discouragement of collusion and attractiveness to potential bidders. Employing multiple BDs may result in more total potential investors bidding on the issuer’s bonds, and thus less uncertainty regarding the common value of the next auction reset rate.

Although MARS auction design inadequately aligns the interests of issuers with those of the broker-dealer community, what matters for lowering rates is more bidders resulting in broader search for potential investors. Market power often gives firms the ability to engage in unilateral anti-competitive behavior. A single BD exhibits market power by eliminating competing BDs from participating in U.S. municipal auction rate securities auctions, thus guaranteeing receipt of 100% of auction BD fee revenue. Additionally, as sole BD the placing of a clearing bid when investor orders are insufficient prevents a MARS auction from failing and essentially establishes the BDs own market interest rate. By adjusting demand the auction reset rate is driven down from the maximum rate that would be set otherwise to a rate ensuring profitable secondary market liquidation of BD inventory. Tacit collusion between several BDs controlling the market for a particular security may result in considerable market power over the security's auction process and not result in lower rates. Broker-dealers may influence rates either to compensate for inventory risks or to induce more successful bids to reduce inventory. The market power of a single BD facilitates these actions more successfully than multiple BD MARS where collusion may be less of a problem.

A group of perhaps 3 or more BDs may limit market power by increasing the intensity of search for potential investors and by competing for the right to absorb any excess supply of funds during an auction, thus earning the 25bp per annum BD fee applying to these securities. The more potential investors each BD brings to a multiple broker-dealer MARS auction, the greater the chance of maintaining control of its securities and the BD fee. In multiple broker-dealer groups it is more likely that the level and value of one or more such BD's inventory positions will allow more aggressive bidding, as needed, for the broker-dealers own account.

The objectives of this paper are twofold. We examine whether issuers of U.S. municipal auction rate securities significantly reduced their interest rates by choosing to employ multiple BDs as market agents rather than employing a single BD as was commonly done in the MARS market. Secondly, unlike other studies, we do not assume that interest rates connected to groups of BDs are constant over time; in other words, we do not assume time-parametric heterogeneity in our parameter estimates.

We show that greater underwriter search for potential investors in the form of multiple BDs is shown to result, on average, in lower municipal interest rates for issuers of U.S. municipal auction rate securities. Our results support auction theory and empirical evidence that in MARS uniform-price multi-unit repeated auctions, use of more than 2 BDs results in competition that lowers rates to the issuer. However, even though these results hold for about 80% of the security's early life as according to our sample, they do not hold for the entire life of the security--a result only captured using our methodology. In fact, under the assumption of parametric homogeneity, one may be led to conclude that there is little competition among BDs. We discuss the whirlwind of market forces that led to the breakdown of competition in the latter periods of the security's life.

2. Model and Data

The simplest form of the model we employ is a static version that assumes interest rates for each trader stay constant over time (similar to those currently employed in the panel data literature in this field). A regression of this form would be written:

(1) $\text{Auction ResetRate}_{it} = b_1 + \sum_{k=2}^{5} b_k BD_k + a_1 x_{it} + v_{it}$,[4]

where the dependent variable Auction Reset Rate is in natural log form to correct for its rightward skew, BD is a time-invariant dummy variable representing a particular number of

[4] It is exactly the time-invariance of the broker-dealer groups that prevents us from using a fixed effects regression model; hence there is no i-subscript for the constant coefficient b_1.

broker-dealers (BDs), $k = 2,...,5$, and zero otherwise (leaving the estimated coefficient of the group with 1 BD to reside in b_1), and the x_{it}'s represent various control variables.

A static regression such as this one suffers from one major violation of our probabilistic assumptions embodied in any regression that will result in a breakdown of statistical adequacy and hence flawed inference [Spanos, 1988, 1999; McAleer, 1994; Edwards et al., 2006; Edwards and Kasibhatla, 2008]. This violation is the fact that *conditional* interest rates on these bonds are not in fact stable over the life of the bond. In other words, we show that given our conditioning set, $b_1 = b_{1t}$ and $b_k = b_{kt}$ where as usual, t represents a time-dynamic subscript.

To properly analyze the broker-dealer group effects on interest rates while taking into consideration the argument of parametric heterogeneity made above, we employed a rolling window methodology. Rolling window estimation is an algorithm that runs a single cross-section regression for each time period while tracking the individual coefficient estimates. Our particular setup takes the form

$$(2)\quad [\text{Auction ResetRate}_i = b_1 + \sum_{k=2}^{5} b_k BD_k + a_1 x_i + v_i]_t, \quad \forall\ t = 1,...,30 .$$

As one can see, we will get a separate result for each time period.

Our sample was selected from tax-exempt and taxable U.S. municipal auction rate securities (MARS) listed by Bloomberg Financial in August 2008 whose rates were reset at auction every 7, 28 or 35-days, for which a complete rate reset history was available, and whose broker-dealers could be confirmed by review of their official offering statements available from Bloomberg.[5] We delineate the bonds separately as those with a single BD up to four BDs, and treat bonds with five or more BDs as a single group. Given the availability of observations in our control variables, we performed a simple data structure algorithm to simultaneously determine the

[5] Bloomberg Finance, LLP.

largest number of bonds and periods covered with each bond while maintaining perfectly balanced panels. To this end, the latter 30 periods of each bond was chosen. By assuring that all panels are balanced, we eliminate the bias in our estimates that may result from some periods covering a different number of bonds than other periods [Edwards and Kasibhatla, 2008]. In all, we have 139 bonds covering 4170 observations.

The control variables that are employed are based on prior research examining the impact of various factors on municipal interest rates.[6] These variables have been shown to influence municipal interest rates and will be used to control their impact on MARS auction reset rates. Variables include characteristics of the transaction such as bond size, initial time to maturity and auction rate reset frequency, as well as attributes of the bond such as bond rating, seasoning, credit enhancement and tax status. A priori, we expect uninsured bonds (Uninsured), time to maturity (Time to Maturity), lower credit ratings (Moody's) and bond size (Bond Size) to be positively related to auction reset rates; on the other hand, we expect tax-free status (Tax Free), alternative minimum tax (AMT) status and bond age (Bond Age) to be negatively related to auction reset rate.

3. Results

Table 1 below lists the coefficient estimates from (1). These estimates incorporate the assumption of parametric homogeneity in the conditional BD rates; in other words, each BD estimate is essentially the mean interest rate (in natural logs) observed over all 30 periods. As the reader will notice, with the slight exception of 3 and 4 BDs, the unconditional mean BD interest

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[6] Kessel,’71; Benson, ’79; Hendershott and Kidwell,’78; Sorensen, ’80; Feroz and Wilson, ’92; Simonson and Robbins,96; Leonard, ’98; Robbins, et al, ‘04

rates in the first column do in fact fall as competition increases. And for the most part, these differences are statistically significant.

Table 1: "Standard" Dynamically Pooled Regression

	BDs Only	Controls Only	BDs and Controls
1 BD	1.402 **		1.634 **
	(0.000)		(0.000)
2 BD's	1.365 **		1.640 **
	(0.000)		(0.000)
3 BD's	1.338 **		1.652 **
	(0.000)		(0.000)
4 BD's	1.345 **		1.653 **
	(0.000)		(0.000)
5 BD's	1.284 **		1.612 **
	(0.000)		(0.000)
Moody's		-0.006 **	-0.008 **
		(0.018)	(0.003)
Uninsured		0.026	0.023
		(0.115)	(0.213)
Tax Free		-0.247 **	-0.252 **
		(0.000)	(0.000)
AMT		-0.220 **	-0.224 **
		(0.000)	(0.000)
Reset Frequency		-0.082	-0.076
		(0.237)	(0.271)
Bond Age		0.001 **	0.001 **
		(0.001)	(0.002)
Time To Maturity		-3.30e-07	-2.36e-07
		(0.818)	(0.905)
Bond Size		7.39e-08	-1.04e-07
		(0.859)	(0.826)
Issue Size		4.90e-11 **	4.90e-11 **
		(0.000)	(0.000)
Constant		1.618 **	
		(0.000)	
Number of Observations	4170	4170	4170
Adjusted R-squared	0.010	0.279	0.279

The constant was left out for ease of interpretability due to the inclusion of all five bond dummies. However, R-squares are calculated properly using the constant. * indicates significance at 10% and ** at 5%. P-values are in parentheses. Dependent variable is the natural log of interest rates.

Table 2 lists the *differences* in magnitude between BD averages with p-values in parentheses. If our hypothesis that more competition brings lower interest rates is true, what we should find in totality is that all upper diagonal differences are positive and statistically significant. Out of the

10 upper diagonal differences, 7 are significant differences, and indeed all 7 are positive. At first, this seems to be fairly good support for our conjecture. However, when adding the control variables, this competitive characteristic goes away.

Considering the third column in Table 1, we find that the interest rates do not in fact fall as competition increases. Evaluating the differences in these interest rates, Table 3 lists the same relationships as in Table 2. It seems as though the addition of the control variables neutralizes the competitive behavior between the groups of BDs recognized by the fact that now only one of the upper diagonal differences is positive and significant. However, as stated earlier, the estimates in Table 1 are biased due to significant parametric heterogeneity. One way to highlight this is via a graphical representation of period-specific estimates of each BDs conditional mean captured in Figure 1.

Table 2: Dynamically Pooled **Differences** in Unconditional Mean Interest Rates for BD Groups

# of Traders	Minus 1	Minus 2	Minus 3	Minus 4	Minus 5
1	0.000 (1.000)	0.037 ** (0.006)	0.064** (0.012)	0.057** (0.034)	0.118** (0.001)
2		0.000 (1.000)	0.026 (0.395)	0.020 (0.550)	0.081* (0.062)
3			0.000 (1.000)	-0.006 (0.794)	0.054** (0.021)
4				0.000 (1.000)	0.061** (0.020)
5+					0.000 (1.000)

P-values in parentheses. * implies significance at 10%, ** implies significance at 5%.

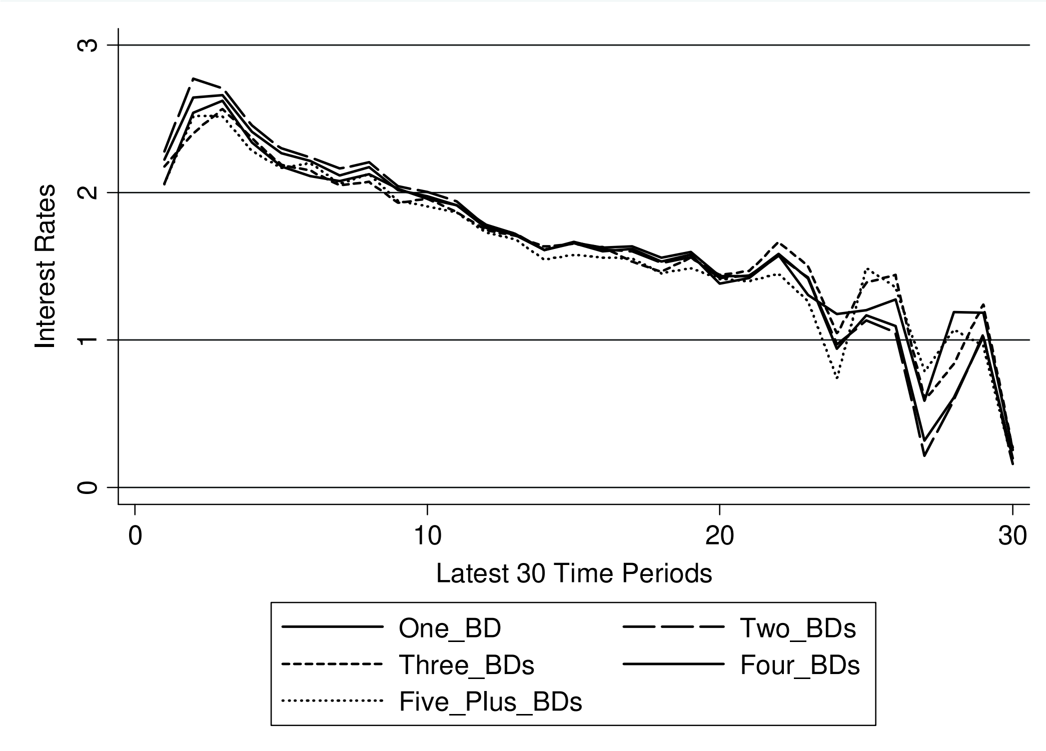
Table 3: Dynamically Pooled Differences in Conditional Mean Interest Rates for BD Groups

# of Traders	Minus 1	Minus 2	Minus 3	Minus 4	Minus 5+
1	0.000	-0.005	-0.017	-0.018	0.022
	(1.000)	(0.459)	(0.466)	(0.485)	(0.475)
2		0.000	-0.011	-0.012	0.028
		(1.000)	(0.685)	(0.673)	(0.439)
3			0.000	-0.001	0.040 *
			(1.000)	(0.960)	(0.077)
4				0.000	0.041 *
				(1.000)	(0.073)
5+					0.000
					(1.000)

P-values in parentheses. * implies significance at 10%, ** implies significance at 5%.

Although difficult to see due to scaling issues, our hypothesis that more broker-dealers results in greater competition and search, thereby leading to lower interest rates, is supported by the plot. One obvious pattern we find is that the dotted line, representing more than five broker-dealers, is consistently lower than the others until about period 24 (which tends to coincide with early 2008 for the vast majority of securities in our sample)**.** On the other hand, the lines depicting one and two BDs is consistently on top. However, since the interesting question lies in the *difference* between the interest rates by broker-dealer group, and since Figure 1 is somewhat difficult to read, we show the differences in the bar charts of Figure 2.

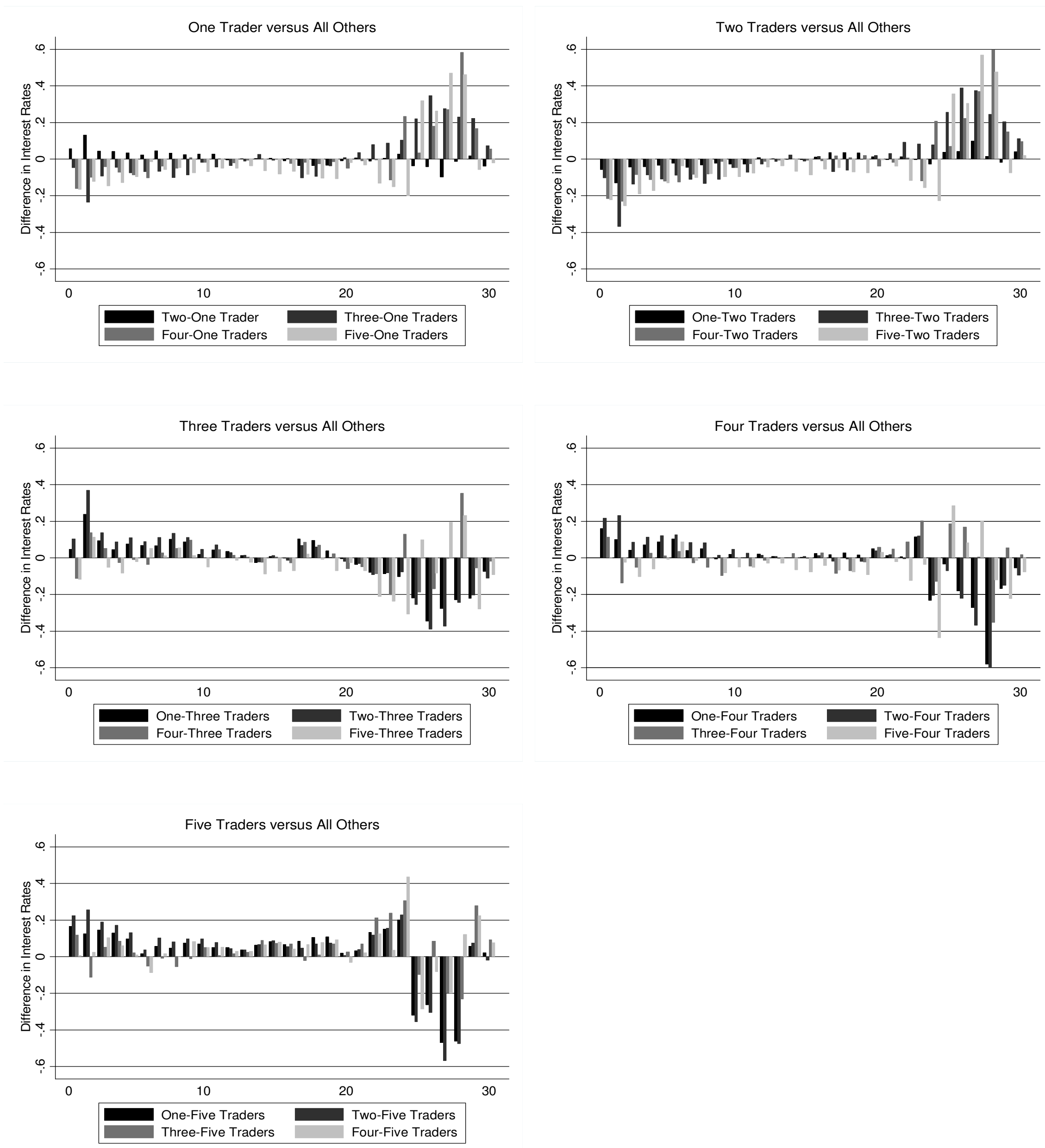
Figure 1: Natural Log of Interest Rates from (2) Grouped by the Number of Broker-Dealers



In Figure 2, we graph the difference in each BD group's interest rate from the others (like the numerical expositions in tables 2 and 3). If our hypothesis is correct we should find that after subtracting 5 BDs' interest rates from the others, all of the bars for this group should be above zero if indeed the interest rate for 5 BDs is lower than the others. At the other extreme, after subtracting 1 BD rates from the others, all bars should reside below zero if the 1 BD group rate is higher than the others.

The reader will notice that the bars through approximately period 23 of each graph become increasing positive as one moves from the single-trader graph to the five-trader graph. In particular, up to approximately period 24, bonds managed by a single BD tend to have higher interest rates than the others with the slight exception of two broker-dealer bonds in early periods. Bonds having 3 BDs have lower rates than the others with the exception of five-trader bonds sporadically throughout. Bonds with four BDs have low rates early on, but then tend to merge in value with most of the other groups, while five or more broker-dealer securities definitely have the lowest rates up to period 24.

Figure 2: Differences in Interest Rates by Broker-Dealer Group



The interest rates from period 24 onward tend to coincide with reset dates occurring in early 2008. Prior to February 2008, market forces as well as bond and issuer characteristics largely determined auction reset rates. Overwhelming auction failure began in the national marketplace the week of February 11, 2008. At the start of this week, Goldman Sachs and other large broker-dealers declined to provide liquidity for most of their auction rate bonds, causing a cascade of other BDs which followed suit. These investment banks were suffering themselves with increasing losses on their own assets, driving capital and liquidity to unexpectedly low levels and necessitating a retrenchment in their borrowings which had supported their purchase of ARS bonds and other securities held in inventory by these firms. Auction failure led to rates being set not by the BDs at auction but by the auction agent, in keeping with bond documentation mandating the Maximum Auction Rate be used in such circumstances. Eighty-five percent of the auctions for bonds in our sample failed commencing on or after the week of February 11th, 2008. No bonds failed prior to February 11th. Interest rates for those bonds that did not fail were also higher on average after Feb 11th than immediately prior.[7] Additionally after March 15, 2008 the U.S. Internal Revenue Service issued a letter ruling confirming that tax-exempt MARS issuers could bid to buy their own bonds if they had the resources to do so, with rates as low as 0% bid for some securities. *Effectively, then, there was a 'shock' to the MARS market that is distinct and allows us to effectively model it separately from our pre-shock observations*.

Having said this, we now check for the statistical significance of the differences in auction reset rates of each broker-dealer group while controlling for heterogeneity in the parameter estimates in the latter periods. Table 4 lists these differences through period 23 and Table 5 lists the same for period 24 and thereafter, i.e., approximately the beginning of the sudden withdrawal

[7] 90% of the bonds in our sample whose auctions did not fail were high quality U.S. tax-exempt bonds. For those bonds that did not fail in the week of Feb 11 and thereafter the average interest rate increase between rate reset dates immediately prior to and just after February 11, 2008 was 2.52%, an increase of 58% on average.

of liquidity by BDs in the MARS market.[8] If our hypothesis is correct, we should find that the upper diagonal in Table 4 lists all positive and statistically significant differences in coefficient value; and this table shows us exactly what we expect to find. The mean interest rates conditioned on our control variables show a definite pattern whereby rates decrease in a statistically significant fashion as more BDs become involved in the auction process. Even though there is the minor exception that having 2 BDs produces higher rates than a single BD, up to an astonishing 1.10 percentage points reduction in *conditional* rates are achieved by increasing competition among BDs (i.e., 2 BDs minus 5 BDs is 0.098 in natural logs; exponentiating, this is equivalent to 1.10 percentage point lower rate with 5 BDs versus just 2 BDs). In fact, out of the differences listed in Table 4, 80% are statistically significant and positive.

Table 4: Mean Differences in Conditional Interest Rates by Number of BDs up to Period 24

# of Traders	Minus 1	Minus 2	Minus 3	Minus 4	Minus 5+
1	0.000 (1.000)	-0.015 * (0.055)	0.040 ** (0.009)	0.041 ** (0.000)	0.082 ** (0.000)
2		0.000 (1.000)	0.056 ** (0.009)	0.057 ** (0.000)	0.098 ** (0.000)
3			0.000 (1.000)	0.001 (0.953)	0.041 ** (0.018)
4				0.000 (1.000)	0.041 ** (0.000)
5+					0.000 (1.000)

P-values in parentheses. * implies significance at 10%, ** implies significance at 5%.

Table 5 tells a different story with interest rates departing from our previous findings. As explained earlier, a whirlwind of market forces resulted in overwhelming auction failure which

[8] We delineate period 24 as the beginning shock period simply due to visual comparisons with previous periods depicted in figures 1 and 2. It is not necessarily the case that our data actually line up with this configuration as each bond has different reset periods. However, even though this is somewhat ad hoc, there is strong visual evidence to justify such a delineation, and the inclusion of the reset frequency variable in equation 2 should control for much of this effect when drawing inference from the estimates listed in tables 4 and 5.

led to rates being set not by the BDs at a competitive auction but by the auction agent. Because of the heterogeneity in the latter periods as illustrated in figures 1 and 2, and because competitive market forces were no longer determining auction reset rates, results shown in Table 5 indicate as expected, that is no significant support of the impact of competition among BDs on auction interest rates.

Table 5: Mean Differences in Conditional Interest Rates by Number of BDs from Period 24 and Beyond

# of Traders	Minus 1	Minus 2	Minus 3	Minus 4	Minus 5+
1	0.000	0.026	-0.210 **	-0.217 **	-0.176
	(1.000)	(0.144)	(0.001)	(0.019)	(0.132)
2		0.000	-0.237 **	-0.244 **	-0.203
		(1.000)	(0.001)	(0.012)	(0.123)
3			0.000	-0.007	0.033
			(1.000)	(0.922)	(0.692)
4				0.000	0.041
				(1.000)	(0.679)
5+					0.000
					(1.000)

P-values in parentheses. * implies significance at 10%, ** implies significance at 5%.

4. Conclusion

The objectives of this paper were twofold. We examine whether issuers of U.S. municipal auction rate securities significantly reduced their interest rates by choosing to employ multiple broker-dealers as market agents rather than employing a single broker-dealer as was commonly done in the MARS market. Secondly, unlike other studies, we do not assume that interest rates connected to groups of BDs are constant over time; in other words, we do not assume time-parametric homogeneity in our parameter estimates.

We show in our analysis that increased competition of multiple BDs is more valuable to the issuer than the market power generated by the single BD MARS market convention. Greater underwriter search for potential investors in the form of multiple broker-dealers is shown to result, on average, in lower municipal interest rates for issuers of U.S. municipal auction rate securities (MARS). Our results support auction theory and empirical evidence that in MARS uniform-price multi-unit repeated auctions, use of more than 2 BDs results in competition that lowers rates to the issuer. Our results hold over the entire sample period studied but for the period following the failure at auction of 85% of our MARS--a result captured clearly using our methodology. We also document and explain the whirlwind of market forces that led to this breakdown in competitive behavior.

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