An Analysis of Credit Default Swap Auctions and Distressed Bond Markets

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April 1, 2011

I. Introduction

Auctions are commonly used to facilitate a process of price discovery. Items bought and sold through auctions vary widely, whether they are pieces of art or government bonds. Auction methodology may also differ dramatically; basic examples of auctions include English, Dutch, First-Price Sealed Bid, and Second-Price Sealed Bid auctions.[1] This paper will focus on a special type of auction that currently serves as the settlement mechanism for credit default swaps (CDS).

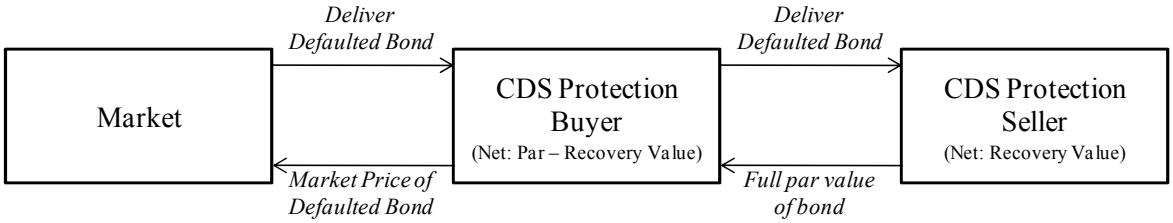
The CDS contract closely resembles an insurance policy written to protect the insured against a credit default of an underlying company obligation. The insured pays regular premiums to the insurer, and the insurer makes the insured whole if the company defaults. For example, if a bank makes a $100 million loan to a company, the bank may wish to insure itself against a future company default by buying credit protection through a CDS contract. However, CDS contracts are unlike insurance in that investors can also buy or sell credit protection using CDS without having any direct ownership of the underlying company's debt securities.[2]

Historically, when a company had a credit event that triggered a settlement under the CDS contract, the two counterparties would settle through what is called physical settlement. In physical settlement, the buyer of the CDS contract would buy bonds from the market (if the bonds were not already owned), deliver the defaulted bond to the seller of the CDS contract, and in return receive the full face value of the bond in cash. Effectively, the CDS buyer is made

[1] Sanjiv Ranjan Das and Rangarajan K. Sundaram, introduction to *Auction Theory: A Survey with Applications to Treasury Markets* (Cambridge: Blackwell Publishers, 1996), page 6.
[2] Erik Sirri, "Testimony Concerning Credit Default Swaps," October 15, 2008, U.S. Securities and Exchange Commission, accessed March 15, 2011, http://www.sec.gov/news/testimony/2008/ts101508ers.htm.

whole and the CDS seller holds the defaulted bond, which is valued according to the bond's expected recovery.[3]

Figure 1: Physical Settlement



However, physical settlement became problematic due to the tremendous growth of the CDS market and the nature of the CDS contract, which does not require any direct exposure to the company's credit. For many companies, by 2005 it was the case that the aggregate notional of the CDS contracts referencing a company's debt obligations exceeded the notional of that company's outstanding debt. Thus, after a company triggered a credit event, the CDS protection buyers, who were looking to buy bonds in order to physically settle the CDS contracts, would face a shortage of available bonds given the overabundance of long CDS investors.[4] Delphi Corporation's 2005 bankruptcy was one of the first major cases of the bond shortage problem. At the time of the CDS settlement, the estimated CDS notional for Delphi was $20 billion with only $2 billion of Delphi bonds available.[5]

In response to the CDS settlement problem, Markit and Creditex, two organizations that help to administrate the CDS market, designed a CDS auction that makes the settlement process both more transparent and orderly.[6] The auction design will be described in detail in the

[3] Goldman Sachs FICC Credit Strategies, "New Developments in the CDS Market," in CDS 101, page #s, http://www2.goldmansachs.com/our-firm/ on-the-issues/viewpoint/viewpoint-articles/state-of-the-market-cds101.pdf.
[4] Jean Helwege et al., Credit Default Swap Auctions, page 4, http://www.newyorkfed.org/research/staff_reports/sr372.pdf.
[5] "Delphi Reveals Weakness in CDS Settlement Procedures," *Euroweek*, October 14, 2005, page 1, accessed March 1, 2011, Proquest.
[6] Markit and Creditex, Credit Event Auction Primer, page 1, http://www.markit.com/information/affiliations/fixings/auctions/docs/ credit_event_auction_primer.pdf.

forthcoming sections. From a high-level perspective, this auction is certainly novel given its complexity and unprecedented approach. With the creation of the CDS auction, the settlement of CDS contracts now even differs significantly from the settlement of other financial derivatives, such as Treasury bond futures, which are settled based simply on the spot price of the underlying security on the date of settlement. The CDS settlement, however, depends on the separate, underlying value of the reference entity's bonds. Past history, including the Delphi example mentioned previously, demonstrate that distressed bond prices are not reliable for determining CDS settlement amounts, as the illiquidity of distressed bond markets coupled with an outsized CDS market create potential for market participants to manipulate the value of the bonds. Thus, the CDS auction, a controlled process designed to produce a fair result, is a crucial element of CDS settlements.

Price discovery, a key aspect of all financial markets, is of particular interest for the CDS auction in light of the auction's distinct characteristics. This study will track bond trading prices and volumes five business days before and after a set of recent CDS auctions, then analyze how the various dynamics of CDS auctions impact bond prices as well as post-auction price variances and trading volumes. A particular goal of this study is to understand the role of CDS auctions in the price discovery process, but the auction's impact on post-auction trading volumes is also examined.

The study finds mixed results for the auction's effectiveness in price discovery. On the one hand, the auction final price is found to be a statistically significant predictor of post-auction prices, while pre-auction trading levels show little predictive value. The findings suggest that the auction provides significant information beyond what is contained in pre-auction prices. On the other hand, if indeed the auction provides price discovery information to the market, one would

expect that price variance would go down in post-auction trading, since there should be less uncertainty about what the bonds are worth. However, this study finds the opposite. Price variance rises after the auction, which suggests that price discovery through the auction process is imprecise or that the market dynamics are somehow changed after the auction is complete. One potential explanation for this result is that many investors/traders may wait until after the auction to purchase bonds, resulting in increased post-auction trading volume and higher price volatility. These market participants may avoid pre-auction markets given the uncertainty of the auction final price or the potential opportunity to buy the distressed bonds at a discount after the auction. This study also shows that post-auction trading volumes are closely correlated to the net open interest in the auction. Finally, while there is not currently enough data to fully understand how auction variables and market prices/volumes interact, this paper raises some questions for future research on auction behaviors and pre- and post-auction markets.

II. Description of the CDS Auction

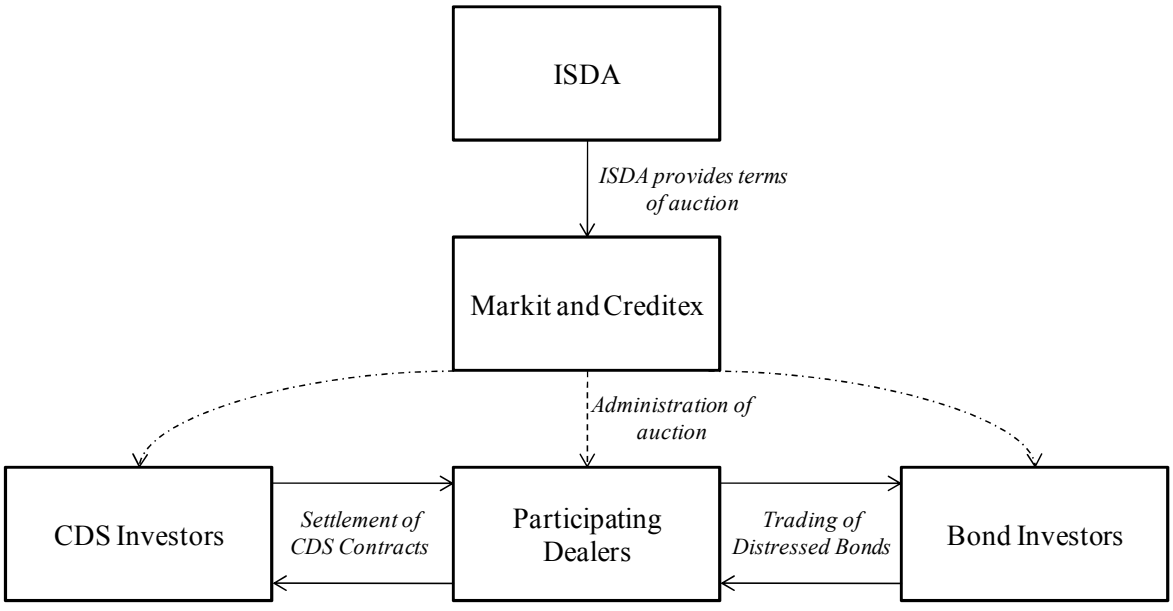
The CDS auction is a complicated, multi-stage process. This section of the paper will outline the auction process in detail and provide analysis on each aspect of the auction. Broadly, there are two stages in a CDS auction. The first stage is largely designed to help the market gather more information and to determine the net supply/demand of bonds to be traded. The information from the first stage is then published by the auction administrators, the market is given time to analyze the information, and the second stage of limit orders is then initiated.[7]

[7] Ibid., 1.

II.1 Overview of Auction Participants

There are a number of participants in the auction process. Firstly, for each auction, the International Swaps & Derivatives Association (ISDA) publishes a document called the CDS protocol, which is released before the auction and specifies the various auction terms. On the day of the auction, the auctions are administrated by two companies called Markit and Creditex. These companies collect information in the first stage of the auction, publish this information between the first and second stages of the auction, and facilitate the operational transactions that must occur after the auction. The next set of participants in the auction are investment banking dealers, which are referred to in auction protocols as participating dealers. Certain dealers are participants in all auctions as Global Dealer Voting Members. Others are included as participating dealers because of their involvement in special CDS committees that oversee the CDS settlement of the relevant defaulted company, and still others join the auction through an application to ISDA.[8] There are on average twelve participating dealers in each auction.

Figure 2: Auction Participants



[8] International Swaps and Derivatives Association, Inc., 2009 CIT Group Inc. Credit Derivatives Auction Settlement Terms, page 2.

The final set of participants are investors, who may be interested in the auction because of previous CDS holdings or because they see an opportunity to purchase the defaulted company's bonds at a discount to intrinsic value through the auction. The roles of the participating dealers and investors will be outlined in the forthcoming sections.

II.2 Physical Settlement Requests

As described in the introduction, a problem with the settlement process before the creation of the auction was that long CDS investors had to buy bonds in the open market in order to physically settle their CDS contracts. This process became more complicated as the CDS market grew, since the CDS market was often larger than the bond market.

The CDS auction process takes advantage of the fact that the net exposure of the entire CDS market for any given security is zero; each long CDS position is directly matched with a short CDS position. With the creation of the CDS auction, almost all CDS contracts are now cash settled.[9] However, the market value of the defaulted bonds at the time of the auction is still the major determinant of those CDS cash settlement amounts. The auction is designed to determine the *net* supply/demand of the defaulted bonds, then find the market price that clears this inventory of bonds.[10]

The auction process depends on the collection of physical settlement requests (PSR) from the various auction participants. A PSR is simply a request to buy or sell a certain face value of bonds at the final auction price. Before the auction, ISDA publishes a list of bonds that are

[9] Markit and Creditex, 2.

[10] It is helpful to understand the various traders or investors that may have an interest in these bonds. For example, after a triggering credit event, investors that were previously long the company's bonds and also long CDS contracts would likely want to sell the bonds and receive cash from the CDS settlement, resulting in a 100% cash position. Alternatively, an investor may have sold CDS and may still believe the defaulted bonds are undervalued compared to what can be recovered through bankruptcy proceedings or restructuring, and thus may want to purchase bonds through the auction.

eligible for PSRs. These bonds are called deliverable obligations and are composed of the company's defaulted securities.

Table 1: Example List of Deliverable Obligations for Idearc Auction[11]

Issuer	Coupon	Maturity	CUSIP
Idearc	8.00%	11/15/2016	451663AC2
Idearc	8.00%	11/15/2016	451663AA6

The submission of PSRs follows the process described below.[12]

- Before the auction, the Participating Dealers receive PSRs from customers (CDS investors) that wish to buy or sell the defaulted bonds. ISDA requires that the PSRs submitted by customers must not be in excess of that customer's market position, meaning that the PSR order size can match but may not exceed the aggregate amount of bonds that the customer would need to trade in order to obtain an identical risk profile. For example, if before the auction, the customer is long $100 million face value of bonds and also long $100 million in CDS (net neutral), the customer can submit a PSR to sell $100 million bonds or less, but may not submit a PSR with a face value of more than $100 million or a PSR to buy any amount of bonds.[13]
- The Participating Dealers then submit PSRs based on their net exposure, which includes the customer PSR requests. The dealers also must submit orders that are no greater than their market positions.
- Once a PSR is submitted, it cannot be changed and the participating dealer or customer is locked into a trade to buy/sell bonds regardless of the auction final price.

[11] Data is from Creditex and Markit and are available on http://www.creditfixings.com.
[12] International Swaps and Derivatives Association, Inc., 3.
[13] In this case, the investor will remain net neutral after the auction since $100mm bonds will be sold through the auction and the CDS contract will be cash settled.

After all of the PSRs are submitted, the PSRs are aggregated by the auction administrators. If there are more sell requests than buy requests, the net open interest is to sell, and the second stage of the auction is comprised of limit bids to buy this open interest in bonds. Conversely, if the net open interest is to buy, then investors/dealers will submit limit offers to sell existing holdings of bonds.[14] The process for determining the final auction price using the net open interest is described in Section II.5.

II.3 Initial Market Submissions

The first stage of the auction involves the participating dealers providing indicative prices (both bids and offers) for the underlying company's bonds. The bids and offers given by the bank represent prices at which the bank is willing to trade a given face amount of bonds, with the face amount (generally between $2mm and $5mm) being specified by ISDA in the CDS protocol. This amount is called the Initial Market Quotation Amount. ISDA also specifies an appropriate bid-offer spread. An example of the submitted bids and offers for the CIT Group auction is shown in Table 2.

Table 2 - Initial Market Submissions for CIT Group Auction[15]

Dealer	Bid	Offer
Banc of America Securities LLC	69.25	71.25
Barclays Bank PLC	67	69
BNP Paribas	69	71
Citigroup Global Markets Inc.	68.75	70.75
Credit Suisse International	70	72
Deutsche Bank AG	70.25	72.25
Goldman Sachs & Co.	66.5	68.5
HSBC Bank USA, National Association	69	71
J.P. Morgan Securities, Inc.	69.75	71.75
Morgan Stanley & Co. Incorporated	68	70
Nomura International PLC	70	72
The Royal Bank of Scotland PLC	69	71
UBS Securities LLC	70	72

[14] Markit and Creditex, 4.
[15] Data is from Creditex and Markit.

ISDA's purpose in gathering the initial bids and offers is to establish an Initial Market Midpoint (IMM). The IMM is published by the auction administrators and provides a benchmark for the market on the relevant bond pricing. In addition, the IMM provides a cap/floor of the final auction price, depending on the direction of the net open interest. The mechanism for how this cap/floor works is detailed in section II.4.

Calculation of Initial Market Midpoint

The process for setting the Initial Market Midpoint (IMM) is as follows:

- The initial bids and offers are sorted, with bids sorted in descending order (from high to low) and offers sorted in ascending order (from low to high).
- Each bid is matched with a corresponding offer. For example, the highest bid is matched with the lowest offer, the second highest bid is matched with the second lowest offer, etc.
- Matched bids and offers that form a tradeable market are removed from the data. In Figure 3, the first three matched bids and offers are removed from the data since the bids are lower than the offers. Only non-tradeable bids and offers are used in the IMM calculation.
- Of the remaining matched bids and offers, the "best half" of the pairs are then used to calculate the IMM. The "best half" is composed of the matched bids and offers in the first half of the remaining non-tradeable pairs. If there is an odd number of matched pairs, then the number of pairs used is rounded up (e.g. if there are nine matched pairs, the "best half" will include five pairs).

Figure 3: Tradeable Markets and Best Half (CIT Auction)[16]

Dealer	Bids (Sorted from High to Low)		Offers (Sorted from Low to High)	Dealer
Deutsche Bank AG	70.25	*Tradeable*	68.5	Goldman Sachs & Co.
Credit Suisse International	70	*Tradeable*	69	Barclays Bank PLC
Nomura International PLC	70	*Tradeable*	70	Morgan Stanley & Co. Incorporated
UBS Securities LLC	70	*Non-Tradeable, Best Half*	70.75	Citigroup Global Markets Inc.
J.P. Morgan Securities, Inc.	69.75	*Non-Tradeable, Best Half*	71	BNP Paribas
Banc of America Securities LLC	69.25	*Non-Tradeable, Best Half*	71	HSBC Bank USA, National Association
BNP Paribas	69	*Non-Tradeable, Best Half*	71	The Royal Bank of Scotland PLC
HSBC Bank USA, National Association	69	*Non-Tradeable, Best Half*	71.25	Banc of America Securities LLC
The Royal Bank of Scotland PLC	69		71.75	J.P. Morgan Securities, Inc.
Citigroup Global Markets Inc.	68.75		72	Credit Suisse International
Morgan Stanley & Co. Incorporated	68		72	Nomura International PLC
Barclays Bank PLC	67		72	UBS Securities LLC
Goldman Sachs & Co.	66.5		72.25	Deutsche Bank AG

- The IMM is calculated as the arithmetic average of the best half, rounded to the nearest fraction of a percentage point (the relevant fraction is provided in the CDS protocol). In the example provided in Figure 3, the IMM would equal the average of the following bids and offers {70, 69.75, 69.25, 69, 69, 70.75, 71, 71, 71, 71.25}, resulting in an IMM of 70.25 after the IMM is rounded to the nearest eighth of a percentage point. [17]

Penalties for Off Market Trades

The participating dealers are expected to submit initial bids and offers based on their best estimates of the fair market value of the defaulted bonds. To protect against off-market bids, ISDA built a penalty system into the auction process to deter off-market initial bids and offers. These penalties are called adjustment amounts and are charged to the participating dealers if their submitted bids and offers are off-market. The adjustment amounts are calculated according to the process described below.

[16] Data is from Creditex and Markit.
[17] The IMM is rounded as per the guidelines set in the CDS protocol. International Swaps and Derivatives Association, Inc., 3-5.

- If the net open interest is to ***sell***, then the adjustment amount is the maximum of zero and the dealer's Initial Market Bid minus the IMM, multiplied by a notional amount that is set by ISDA.[18] The adjustment amount is only levied if the dealers Initial Market Bid does not cross with any other Initial Market Offer.
- If the net open interest is to ***buy***, then the adjustment amount is the maximum of zero and the dealer's IMM minus the Initial Market Offer, multiplied by a notional amount that is set by ISDA. The adjustment amount is only levied if the dealers Initial Market Offer does not cross with any other Initial Market Bid.

Adjustment amounts are also published by the auction administrators after the first round of the auction. The proceeds of the adjustment amounts go to ISDA and are used to defray the costs of the auctions. If adjustment amounts exceed the auction administration costs, there is a possibility that ISDA will make distributions to dealers in the future.[19] Historically, adjustment amounts have been minimal.

II.4 Publication of Data and Waiting Period

After the auction administrators add up the total physical settlement requests and after the IMM is calculated, they publish the total buy requests, total sell requests, the net open interest, all of the participating dealer's initial bids/offers, the IMM, and any adjustment amounts. The market is then given a ninety-minute to two-hour window to digest this information. After this waiting period, the second stage of the auction begins.[20]

[18] For example, in the Visteon auction, the net open interest was to sell, the IMM was 4.75% of par, JP Morgan's initial bid was 6%, and the notional set by ISDA was equal to $2mm. This resulted in an adjustment amount of $25,000.
[19] International Swaps and Derivatives Association, Inc., 5-6.
[20] Ibid., 6-7.

II.5 Second Stage of the Auction

The second stage of the auction is similar to the auction used by the US government in selling US Treasury bonds. The supply of bonds is equal to the net open interest and is known before the collection of orders. The final price is equal to the price of the last order that fills the supply of bonds, with all "winning" bidders trading the bonds at the market clearing price.

Figure 4: Second Round of Auction (Visteon Auction)

Net Open Interest to Sell	-$180 mm
Final Auction Clearing Price	$3

Dealer	Bid	Size of Order ($mm)	Cumulative Orders ($mm)	
J.P. Morgan Securities, Inc.**	4.75*	2	2	
Credit Suisse International	4.75*	20	22	
J.P. Morgan Securities, Inc.	4.75*	10	32	
The Royal Bank of Scotland PLC**	4.5*	2	34	
HSBC Bank USA, National Association**	4*	2	36	
Citigroup Global Markets Inc.**	4*	2	38	
UBS Securities LLC **	4*	2	40	All these bidders buy the bonds at the market clearing price of $3
Barclays Bank PLC**	4*	2	42	
BNP Paribas**	4*	2	44	
Credit Suisse International**	3.5*	2	46	
UBS Securities LLC	3.5*	10	56	
Banc of America Securities LLC	3.375*	91	147	
Goldman Sachs & Co.**	3.25*	2	149	
Morgan Stanley & Co. Incorporated**	3.25*	2	151	Net open interest is filled at a price of $3
Banc of America Securities LLC**	3^	2	180	
UBS Securities LLC	3^	25	180	
Credit Suisse International	3^	8	180	Partially filled orders
J.P. Morgan Securities, Inc.	3^	20	180	
Deutsche Bank AG**	2.5	2		

* Orders that were completely filled

^ Orders that were partially filled.

** Indicates that these orders were carried over from the first stage of the auction (Initial Market Submissions)

Initial Market Submissions Carried Over Into Second Round of Auction

Either the bid or offer of each dealer's initial market submission is carried forward into the second round of the auction as a limit order, depending on the direction of the net open interest. If the net open interest is to sell, then the dealer's Initial Market Bids in the first round of the auction become limit bids in the second round, with a face amount equal to the amount set

by ISDA before the auction. If the net open interest is to buy, the dealer's Initial Market Offers become limit offers in a similar fashion. If there were any adjustment amounts, then the dealer's indicative bid/offer is revised and becomes a limit buy/sell order with a price of the IMM.[21]

Initial Market Midpoint Provides Cap/Floor on Auction Final Price

In order to prevent manipulation of the auction final price in the second round, ISDA sets a price cap/floor on the auction final price in the case that the net open interest is to sell/buy, respectively.

- If the net open interest is to sell, then the auction final price is capped at the IMM + Cap Amount. The Cap amount is equal to one-half of the Bid-Offer Spread that the participating dealers adhered to in the first round of the auction.
- If the net open interest is to buy, then the auction final price is floored at the IMM - Cap Amount.

The cap amounts are included in the auction to provide a safeguard against large limit orders that could potentially manipulate the auction final price, especially if the net open interest is relatively small. For example, if there is a CDS investor that sold a large amount of protection, it is in this investor's interest for the auction final price for the underlying bonds to be as high as possible. If the net open interest is to sell and is a relatively small number, and if there was no cap to the limit order, this investor could offer to buy all of the bonds in the auction at a superficially high price and minimize the payout on the CDS contracts. The cap limits the ability of this type of investor to manipulate the final price.[22]

[21] Ibid., 3.
[22] Markit and Creditex, 8.

Auction Final Price if Net Open Interest Not Filled or Zero

The CDS auction also has provisions for the special cases where the aggregate amount of limit orders in the second round are insufficient to cover the net open interest. If the net open interest is to sell and the net open interest is not filled, the auction final price is set to zero. If the net open interest is to buy, then the final price is set to par. If the net open interest is zero, then the Auction Final Price equals the Initial Market Midpoint.[23]

III. Description of Data and Summary Statistics

The data used in this study centers around various aspects of CDS auctions between 2008 and 2009 as well as trading prices of the bonds that were relevant to each auction. The CDS data was collected from Creditex, one of the auction administrators, and is currently available at www.creditfixings.com. Bond prices, which were collected over a ten trading day range (five business days before and after the date of the auction), were gathered from publically available TRACE data. This data is collected and published by the Financial Industry Regulatory Authority (FINRA).

The auctions analyzed in this study are limited to auctions for which the deliverable obligations are bonds (no LCDS auctions are analyzed) and for which TRACE Data is available. The data set includes twenty-three auctions.

[23] International Swaps and Derivatives Association, Inc., 8-9.

Table 3: Overview of Auction Data[24]

Issuer	Initial Market Midpoint	Auction Final Price	Open Interest ($mm)	Issuer	Initial Market Midpoint	Auction Final Price	Open Interest ($mm)
CIT	$70.25	$68.13	-$729	Great Lakes	22.875	18.25	-130.632
Lear	$40.13	$38.50	-$173	Chemtura	20.875	15	-98.738
Six Flags	$13.00	$14.00	$62	Station Casinos	29.375	32	24
Visteon	$4.75	$3.00	-$180	Smurfit-Stone	7.875	8.875	-128.675
GM	$11.00	$12.50	$529	Nortel Corporation	12.125	12	-290.47
RH Donnelley	$4.88	$4.88	-$144	Nortel Limited	7.625	6.5	-12.916
Bowater	$14.00	$15.00	-$118	Lyondell	23.25	15.5	-143.238
Idearc	$1.38	$1.75	-$890	Tribune	3.5	1.5	-765
Capmark	$22.38	$23.38	-$115	Washington Mutual	63.625	57	-988
Charter	$1.38	$2.38	-$49	Lehman	9.75	8.625	-4920
Abitibi	$3.75	$3.25	-$234	Quebecor	42.125	41.25	-66
Rouse	$28.25	$29.25	-$9				

Table 4: TRACE Data (Weighted Average Prices by Day)[25]

	Days Relative to Auction Date									
Issuer	**-5**	**-4**	**-3**	**-2**	**-1**	**+1**	**+2**	**+3**	**+4**	**+5**
CIT	68.10	67.78	68.18	68.11	69.38	68.38	69.87	69.10	69.20	68.84
Lear	39.98	38.73	39.19	35.44	39.40	38.55	40.39	42.12	43.32	43.76
Six Flags	12.94	13.97	13.32	13.38	13.27	13.99	13.35	13.57	13.15	14.00
Visteon	6.72	6.00	6.38	4.50	4.88	3.05	4.01	3.25	3.00	
GM	10.86	10.66	11.42	11.28	11.74	12.48	12.36	12.20	11.94	12.38
RH Donnelley	5.01	5.12	6.08	5.48		4.89	4.82	4.68		4.44
Bowater	12.74	13.15	14.88	14.72	14.13	15.29	15.50	16.42	17.66	15.00
Idearc	2.06	2.08	1.77	1.94	2.12	1.78		1.76	1.75	1.72
Capmark	22.69	33.19	27.63	28.42	22.74	24.42	29.50	25.64	27.24	26.56
Charter	9.00	8.70	9.29	9.00	3.16	1.94	2.24	1.73	5.61	8.00
Abitibi	4.74	6.00	4.94	4.50	4.43	3.97	3.84	4.69	5.11	5.41
Rouse	31.91	30.10	35.10	30.05	29.03	34.43	37.83	36.01	38.10	39.92
Great Lakes	27.00	27.81	27.87		26.78	20.33	20.34	20.07	18.28	19.95
Chemtura	27.00	27.81	27.87		26.76	16.97	18.17	19.00	17.40	19.95
Station Casinos	30.00	29.92		26.98	29.00	35.54	32.35	34.64		30.88
Smurfit-Stone	12.69	8.71	16.00	6.76	8.74	10.26	8.72	10.43	8.76	6.99
Nortel Corporation	16.63	16.40	15.75	15.00	14.28	12.25	13.17	13.48	12.19	13.52
Nortel Limited	16.73	16.46	16.00	15.20	14.09	10.71	10.13	12.77	12.19	13.52
Lyondell	25.00	26.79	25.75	27.71		17.98	16.56	18.12	17.65	19.92
Tribune	4.96	4.49	4.44	4.57	4.26	3.43	2.91	4.58	4.54	4.32
Washington Mutual	68.28	68.18	66.11	65.19	64.97	57.00	56.98	57.60	58.39	61.29
Lehman	13.89	12.55	12.85	13.06	13.09	9.79	8.84	8.83	9.45	10.06
Quebecor		41.92	42.59	42.78	42.00	43.02	44.99	46.14	46.15	45.76

[24] Data is from Creditex and Markit.

[25] Wharton Research Data Services (WRDS) was used in preparing this TRACE bond data. This service and the data available thereon constitute valuable intellectual property and trade secrets of WRDS and/or its third-party suppliers.

The TRACE bond data is a sequential set of data that provides a date, timestamp, notional amount, and price for each bond trade in any given day. The analysis in this study focuses on the weighted average bond prices on each day. One limitation on the data is that for trades over $1 million dollars in face value, TRACE provides a notional of "$1MM+." As a result, in this data set, it is impossible to decipher a $20 million trade from a $1 million trade. Thus, a simplifying assumption used in this study is to substitute a trade with a face value of $5 million dollars for any trades in the "$1MM+" category.

As previously stated, the major goal of this study is to track bond prices before and after each CDS auction to determine if the auction itself has an impact on the market for the relevant bonds. Overall, there is tremendous variation in price performance of the bonds. While there are certainly other factors that could have impacted the bond prices during the time of the CDS auction (e.g. interest rates, new company filings, etc), this study only focuses on the impact of the CDS auctions on markets. Figure 5 and Table 5 provide an example of the price data that is examined in this study.

Figure 5: Bond Prices and CDS Auction Results from Lehman Brothers Auction

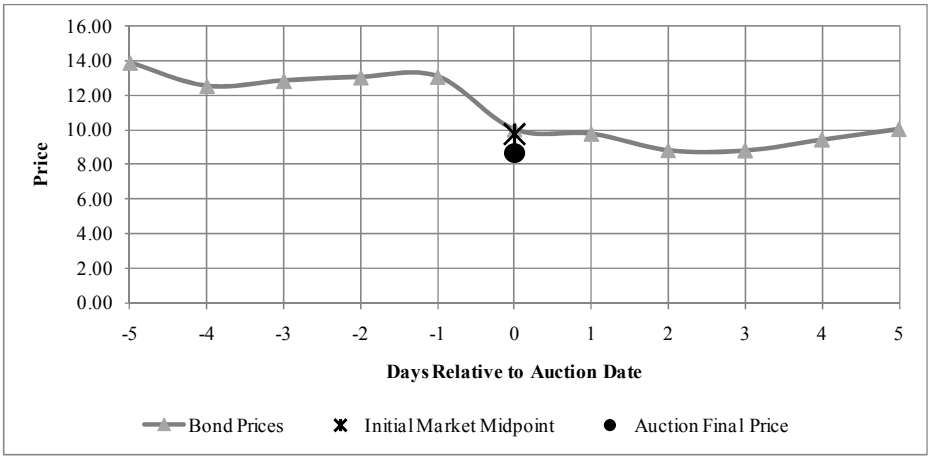


Table 5: Price Deviation: Bond Price vs. Auction final Price

Issuer	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5
CIT	-0.04%	-0.50%	0.08%	-0.03%	1.84%	0.37%	2.57%	1.43%	1.58%	1.05%
Lear	3.83%	0.59%	1.78%	-7.96%	2.33%	0.13%	4.90%	9.40%	12.53%	13.65%
Six Flags	-7.54%	-0.22%	-4.88%	-4.41%	-5.21%	-0.09%	-4.66%	-3.05%	-6.06%	0.00%
Visteon	124.07%	100.00%	112.50%	50.00%	62.50%	1.67%	33.76%	8.31%	0.00%	
GM	-13.15%	-14.74%	-8.60%	-9.80%	-6.11%	-0.18%	-1.15%	-2.37%	-4.46%	-0.96%
RH Donnelley Corporation	2.69%	5.03%	24.79%	12.35%		0.25%	-1.06%	-3.96%		-8.97%
Bowater	-15.10%	-12.35%	-0.83%	-1.87%	-5.83%	1.91%	3.33%	9.48%	17.71%	0.00%
Idearc	17.60%	19.13%	1.30%	10.74%	21.20%	1.95%		0.42%	0.03%	-1.55%
Capmark	-2.94%	41.99%	18.18%	21.58%	-2.73%	4.47%	26.20%	9.67%	16.55%	13.62%
Charter	278.95%	266.49%	291.33%	278.95%	33.18%	-18.19%	-5.65%	-27.15%	136.33%	236.84%
Abitibi	45.90%	84.62%	52.02%	38.45%	36.30%	22.14%	18.11%	44.30%	57.10%	66.35%
Rouse	9.10%	2.91%	20.00%	2.74%	-0.76%	17.72%	29.33%	23.12%	30.26%	36.48%
Great Lakes	47.95%	52.38%	52.69%		46.73%	11.41%	11.43%	9.97%	0.17%	9.30%
Chemtura	80.00%	85.40%	85.78%		78.39%	13.13%	21.16%	26.65%	16.02%	32.98%
Station Casinos	-6.25%	-6.51%		-15.70%	-9.38%	11.06%	1.09%	8.26%		-3.52%
Smurfit-Stone	42.98%	-1.83%	80.28%	-23.84%	-1.50%	15.65%	-1.79%	17.52%	-1.34%	-21.29%
Nortel Corporation	38.54%	36.65%	31.25%	24.98%	19.02%	2.07%	9.74%	12.29%	1.56%	12.64%
Nortel Limited	157.37%	153.25%	146.15%	133.89%	116.72%	64.76%	55.88%	96.45%	87.47%	107.95%
Lyondell	61.29%	72.84%	66.13%	78.77%		15.99%	6.86%	16.90%	13.85%	28.51%
Tribune	230.48%	199.47%	196.27%	204.44%	183.99%	128.75%	94.12%	205.22%	202.86%	188.29%
Washington Mutual	19.79%	19.62%	15.98%	14.38%	13.99%	-0.01%	-0.03%	1.06%	2.44%	7.53%
Lehman	61.08%	45.46%	48.94%	51.37%	51.73%	13.52%	2.46%	2.34%	9.61%	16.69%
Quebecor		1.62%	3.24%	3.71%	1.82%	4.28%	9.06%	11.86%	11.88%	10.93%
Average	53.48%	52.26%	58.63%	42.95%	31.82%	14.02%	14.60%	21.19%	29.71%	35.03%
Median	29.17%	19.62%	28.02%	12.35%	13.99%	4.28%	5.88%	9.48%	11.88%	11.79%

IV. Results

IV.1 CDS Auctions as Price Discovery Mechanisms

Price discovery is a fundamental issue in all financial markets. The price discovery process is particularly interesting for CDS auctions, given the auction's complexity and unique characteristics. The first key distinction of CDS auctions compared to other auctions is that the CDS settlement cannot be determined on a standalone basis, and is based completely on the market value of the reference entity's bonds. For example, even with a financial derivative contract such as a Treasury bond futures contract, the settlement is based simply on the Treasury bond spot price on the date of settlement.[26] However, since the CDS settlement must be determined based on the value of the underlying bonds, it is necessary for the market to have a

[26] John C. Hull, Options, Futures, and Other Derivatives (Upper Saddle River: Pearson Education, 2003), page 23.

reliable way to value the bonds at the time of CDS settlement. Settling CDS contracts based on the prevailing bond price at time of settlement is impractical because the distressed bond market historically has been extremely illiquid. Therefore, market participants would not want to rely on the market to efficiently price these bonds given the low trading volume. Furthermore, low liquidity and unequally sized markets (aggregate CDS market often much larger than outstanding, underlying bonds) raise the possibility of market manipulation. Thus, the effectiveness of the CDS auction in providing a fair price is extremely important for the CDS market.

Data from the auctions analyzed in this study demonstrates that the CDS auction's effectiveness as a price discovery tool is mixed. On the one hand, the auction final price is a statistically significant predictor of post-auction prices, which indicates that that the auction provides significant price discovery information to the market and is working properly to settle CDS contracts. However, this study finds that price variance increases after auctions, which is contrary to expectations. If the auction indeed provides information beyond what is available in pre-auction markets, then one would expect price volatility to decrease after the auction is completed. This result suggests that price discovery through the auction process is inexact. The methodology and numerical results of this study, as well as a potential explanation for the mixed results are provided in the following sections.

Impact of Auction Final on Post-Auction Prices

Two linear regressions were used in this study in order to analyze whether the auction final price provides information above and beyond what is in the pre-auction trading levels and

to evaluate how well the auction's final price predicts post-auction prices. The variables of each regression are outlined in Tables 6 and 8.

The first regression is designed to evaluate how well pre-auction prices of the distressed bonds predict post-auction prices. If pre-auction trading levels are predictive of post-auction prices, then the expectation would be a higher correlation, with a significant t-stat corresponding to the intercept.

Table 6: Regression 1

Dependent Variable	Independent Variables
$\frac{Post\ Auction\ Price\ (1\ day\ after\ auction)}{Pre\ Auction\ Price\ (1\ day\ before\ auction)}$	$\frac{Net\ Open\ Interest}{Initial\ Market\ Quotation\ Amount}$
	$Variance\ of\ Prices\ One\ Day\ Before\ Auction$
	$\frac{Average\ Volume}{Initial\ Market\ Quotation\ Amount}$

Note: In the first phase of the auction, dealers submit both bids and offers, which represent levels at which they are willing to execute trades with face value equal to the Initial Market Quotation Amount.

The independent variables in this regression were chosen because they provide information as to the market dynamics at the time of the auction. The net open interest provides an indication of the supply/demand of the distressed bonds created by the physical settlements of the bonds. The price variance and trading volumes are included as independent variables because they also could impact on the relative price of pre- and post-auction bonds. Two of the control variables used in this regression (Net Open Interest and Average Volume) were normalized using the Initial Market Quotation Amount, which as previously mentioned is set by ISDA and is representative of the average notional of a CDS trade for the given reference entity. The net open interest and average volume variables are normalized because the sizes of the auctions vary considerably depending on the size of the credit markets for each reference entity.

The results of the first regression are shown below in Table 7. The regression shows extremely weak correlation and therefore suggests that pre-auction prices are poor predictors of post-auction prices. Furthermore, none of the independent variables demonstrate any predictive value for post-auction prices.

Table 7: Results of Regression 1

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.3924
R Square	0.1540
Adjusted R Square	0.0130
Standard Error	0.1879
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0.1157	0.0386	1.0922	0.3778
Residual	18	0.6357	0.0353		
Total	21	0.7514			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.9079	0.0562	16.1564	0.0000	0.7899	1.0260	0.7899	1.0260
Net Open Interest/Initial Market Quotation Amount	0.0003	0.0002	1.6732	0.1116	-0.0001	0.0008	-0.0001	0.0008
Variance of Prices/Initial Market Quotation Amount	-0.0017	0.0116	-0.1462	0.8854	-0.0260	0.0226	-0.0260	0.0226
Avg Volume/Initial Market Quotation Amount	0.0022	0.0019	1.1980	0.2464	-0.0017	0.0062	-0.0017	0.0062

The second regression uses the same variables as Regression 1, but adds the independent variable of *Auction Final Price/Pre-Auction Price*. The purpose of this regression is to see if the auction final price is predictive of post-auction trading levels, and also to see if the auction final price provides more information to the market than what is available through pre-auction trading levels.

Table 8: Regression 2

Dependent Variable	**Independent Variables**
$\frac{Post\ Auction\ Price\ (1\ day\ after\ auction)}{Pre\ Auction\ Price\ (1\ day\ before\ auction)}$	$\frac{Net\ Open\ Interest}{Initial\ Market\ Quotation\ Amount}$
	$Variance\ of\ Prices\ One\ Day\ Before\ Auction$
	$\frac{Average\ Volume}{Initial\ Market\ Quotation\ Amount}$
	$\frac{Auction\ Final\ Price}{Pre\ Auction\ Price\ (1\ day\ before\ auction)}$

Table 9: Results of Regression 2

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.8521
R Square	0.7261
Adjusted R Square	0.6616
Standard Error	0.1100
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.5456	0.1364	11.2647	0.0001
Residual	17	0.2058	0.0121		
Total	21	0.7514			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.2602	0.1136	2.2908	0.0350	0.0206	0.4998	0.0206	0.4998
Net Open Interest/Initial Market Quotation Amount	0.0000	0.0001	-0.1737	0.8642	-0.0003	0.0003	-0.0003	0.0003
Variance of Prices/Initial Market Quotation Amount	-0.0064	0.0068	-0.9328	0.3640	-0.0207	0.0080	-0.0207	0.0080
Avg Volume/Initial Market Quotation Amount	-0.0003	0.0012	-0.2386	0.8143	-0.0027	0.0022	-0.0027	0.0022
Auction Final Price/Pre Auction Price	0.7888	0.1324	5.9583	0.0000	0.5095	1.0681	0.5095	1.0681

The results of Regression 2 (Adjusted R Square of 0.662, large t-statistic value for the Auction Final Price) indicate that the auction final price is a statistically significant predictor of post-auction prices and that the auction plays a major role in the market's price discovery process. This result also suggests that the auction is working properly and providing a fair price for auction participants, even though bond prices generally do rise after the auction is completed.

Impact of Auction on Post Auction Volatility (Variance)

If the auction final price indeed assists the market in price discovery, the expectation is that post-auction price variance should be less than pre-auction price variance, as the auction should provide the market with more pricing information. However, the data analyzed in this study shows that price variance is significantly higher after the auction is completed. This result is particularly surprising given that the auction final price showed significant predictive value.

Table 10: Summary of Price Variance

Company	Variance 2 Days Before Auction	Variance 2 Days After Auction	Variance higher After Auction?
CIT	2.912	1.087	No
Lear	3.039	2.775	No
Six Flags	0.067	1.321	Yes
Visteon	0.063	0.407	Yes
GM	0.616	1.285	Yes
RH Donnelley Corporation	0.891	0.231	No
Bowater	4.033	0.478	No
Idearc	0.079	0.040	No
Capmark	43.196	29.033	No
Charter	11.284	6.785	No
Abitibi	0.679	1.479	Yes
Rouse	6.308	8.112	Yes
Great Lakes	0.169	2.795	Yes
Chemtura	0.162	7.505	Yes
Station Casinos	1.367	3.413	Yes
Smurfit-Stone	7.586	2.758	No
Nortel Corporation	0.460	0.908	Yes
Nortel Limited	0.401	9.195	Yes
Lyondell	4.242	7.996	Yes
Tribune	0.937	2.581	Yes
Washington Mutual	1.698	1.122	No
Lehman	5.627	2.833	No
Quebecor	2.460	2.828	Yes
Average Variance	4.273	4.216	
Median Variance	1.367	2.758	

Price variance in this study is not weighted by the size of each trade. Variance is calculated using the following formula.

$$Variance = \frac{\sum(x-\bar{x})^2}{(n-1)}$$ where $\bar{x}$ is the sample mean.

Limitations to the data include a very small number of trades in both pre- and post-auction trading for certain reference entities. In these cases, changes in variance may not be reflective of a trading environment with increased volatility.

Possible Explanations for Mixed Results

At this point in time, there is not enough data to fully explain the various price discovery dynamics of the CDS auctions. Given the variety of market participants before and after auctions, there are several competing factors that could impact the pricing of bonds pre- and post-auction as well as the final CDS settlement.

For example, one possible explanation for increased variance in post-auction trading is that there are many investors that are unwilling to enter the market until after the auction is completed. Traders may simply avoid the pre-auction markets for the distressed bonds because the market is both illiquid and uncertain. They also may seek opportunity in the post-auction bond prices, as the average and median percentage rises for bonds the day after the auction is 14.0% and 4.3%, respectively.

The pre-auction pricing risk may be especially significant because CDS investors, especially those with offsetting positions (long CDS, long bonds), may be indifferent about bond prices before the auction and thus may distort market prices. The first priority for these investors is to have a settlement process that is orderly and efficient, and since they are assured of this outcome with the auction, their indifference may be reflected in pre-auction trading levels. Distressed bond investors, therefore, may choose to wait until after the CDS auction to purchase bonds. New entrants to the market add new demand to what is already a thinly traded market, and thus may cause increased price variance.

Another possible explanation for the price variance is that the auction amounts may impact the supply/demand dynamics of post-auction markets. Section IV.II discusses how post-auction trading volumes are correlated to the net open interest. The data shows that in general, a higher net open interest to sell leads to higher post-auction trading volume. The increased trading volume may lead to increased price variance, especially given that the pre-market auction markets are thinly traded.

Table 11: Pre-Auction Prices vs. Auction Final Price

Company	Pre-Auction Price	Auction Final Price	% Change
CIT	69.38	68.125	-2%
Lear	39.40	38.5	-2%
Six Flags	13.27	14	5%
Visteon	4.88	3	-38%
GM	11.74	12.5	7%
RH Donnelley Corporation	5.48	4.875	-11%
Bowater	14.13	15	6%
Idearc	2.12	1.75	-17%
Capmark	22.74	23.375	3%
Charter	3.16	2.375	-25%
Abitibi	4.43	3.25	-27%
Rouse	29.03	29.25	1%
Great Lakes	26.78	18.25	-32%
Chemtura	26.76	15	-44%
Station Casinos	29.00	32	10%
Smurfit-Stone	8.74	8.875	2%
Nortel Corporation	14.28	12	-16%
Nortel Limited	14.09	6.5	-54%
Lyondell	27.71	15.5	-44%
Tribune	4.26	1.5	-65%
Washington Mutual	64.97	57	-12%
Lehman	13.09	8.625	-34%
Quebecor	42.00	41.25	-2%
Average			-17%
Median			-12%

IV.II Impact of Auction on Post Auction Trading Volumes

The other area of interest examined in this study is how auction amounts impact post-auction trading volumes. Trading volumes increase dramatically after auctions, as shown in Figure 6 and Table 12. This finding is consistent with the hypothesis that new investors are entering the market after the auction is completed.

Figure 6: Overview of Trading Volume Data

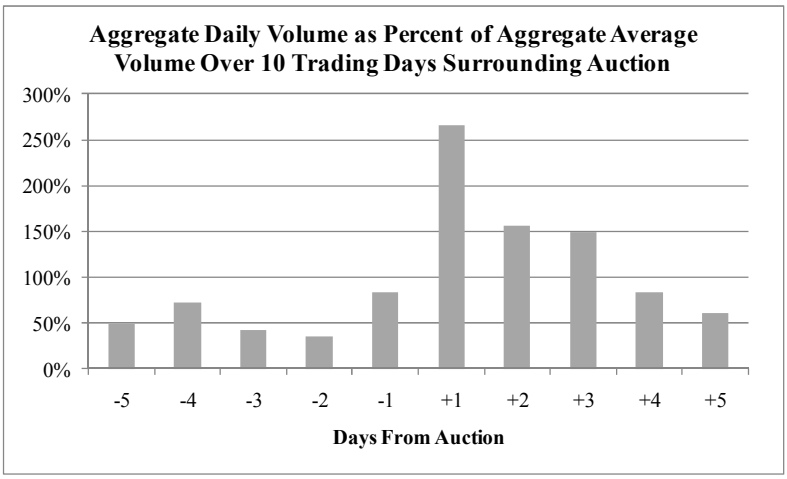


Table 12: Pre Auction vs. Post Auction Volume

	5-Day Average Volume Before Auction ($mm)	5-Day Average Volume After Auction ($mm)	Volume After Auction/Volume Before Auction (%)
CIT	$172.6	$371.9	215%
Lear	$11.4	$110.1	967%
Six Flags	$34.0	$29.7	87%
Visteon	$5.2	$26.1	501%
GM	$134.1	$143.0	107%
RH Donnelley Corporation	$8.9	$33.0	369%
Bowater	$36.5	$57.9	158%
Idearc	$22.0	$34.0	155%
Capmark	$134.4	$121.8	91%
Charter	$3.0	$33.8	1129%
Abitibi	$26.7	$98.1	367%
Rouse	$6.3	$141.8	2268%
Great Lakes	$20.0	$37.4	187%
Chemtura	$21.0	$84.0	400%
Station Casinos	$7.4	$26.1	355%
Smurfit-Stone	$14.7	$33.9	231%
Nortel Corporation	$34.9	$68.8	197%
Nortel Limited	$26.9	$64.0	238%
Lyondell	$23.6	$91.9	389%
Tribune	$26.2	$90.2	344%
Washington Mutual	$165.0	$243.6	148%
Lehman	$447.8	$731.9	163%
Quebecor	$21.8	$106.1	486%
Average	$61.1	$120.8	415%
Median	$23.6	$84.0	238%

Note: Volumes are calculated assuming that "1MM+" trades as provided by TRACE equal $5mm trades.

Trading volumes are also found to be correlated to the net open interest in the auction. Regression 3 shows that the cumulative trading volume in the two days after each auction is highly correlated to the net open interest of the auction.

Table 13: Regression 3

Dependent Variable	Independent Variables
Cumulative Volume (+1 and +2 Days After Auction)	*Open Interest*
	Variance of Initial Bids/Offers
	Variance of Filled Limit Orders

Table 14: Results of Regression 3[27]

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9263
R Square	0.8580
Adjusted R Square	0.8343
Standard Error	82.1304
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	733,346	244,449	36.2393	0.0000
Residual	18	121,417	6,745		
Total	21	854,763			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	48.8849	24.3336	2.0089	0.0598	-2.2382	100.0080	-2.2382	100.0080
Open Interest	-0.1774	0.0172	-10.3319	0.0000	-0.2134	-0.1413	-0.2134	-0.1413
Variance of Initial Bids/Offers	11.2839	12.6403	0.8927	0.3838	-15.2724	37.8402	-15.2724	37.8402
Variance of Filled Limit Orders	-8.6483	11.0803	-0.7805	0.4452	-31.9271	14.6305	-31.9271	14.6305

In most of the auctions (20 out of 23), the net open interest was to sell. As a result, higher net open interests suggest that bidders in the second phase of the auction would look to buy the supply of bonds with the intention of selling those bonds at a higher price or profiting

[27] Although the coefficient for the open interest is negative, the result should be interpreted as the higher the absolute net open interest, the higher trading volume is post auction. In this data set, most of the auctions had net open interests to sell and net open interests to sell were represented as negative numbers.

through a higher recovery in the bankruptcy process/restructuring process. However, regression analysis on post-auction prices show weak correlation to the net open interest of the auction.

V. Conclusion

The key question that this study examines is if the CDS auctions are accurately pricing the underlying distressed bonds. This study finds that auctions clearly provide information beyond what is available in pre-auction trading levels and generally result in a final price in line with post-auction prices. However, the data also shows that post-auction price variance is significantly higher than pre-auction variance, which is contrary to the expectation that more price discovery information would lower volatility. Overall, the price discovery function that the CDS auction provides is inexact. However, one possible explanation for the results is that after the auction is complete, a new set of investors enter the market given reduced uncertainty of market prices or due to the potential opportunity to purchase bonds at a discount to intrinsic value. This explanation is consistent with significantly increased trading volume after the auction, especially in cases where there was a significant net open interest.

Given the complexity and novelty of the auction design, it would be interesting to identify aspects of the auction that can be improved with respect to price discovery. One particular point of interest is the potential impact of a single auction participant, and if this individual investor is able to affect the auction final price. However, currently there is not enough data to accurately track each participant's actions. For example, although the auction administrators provide data on what the participating dealers submit in terms of pricing and physical settlement requests, these amounts are not helpful in understanding the market dynamics as each dealer's submissions are the collection of the dealer's exposures plus customer

order submissions. If more data on auction participants becomes available in the future, these issues may warrant more research.

ACKNOWLEDGEMENTS

I would like to thank my Glucksman faculty advisor, Professor Raghu Sundaram, for his valuable guidance and time.

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