Auction Functionality Worked Examples

VERSION 3.2

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TABLE OF CONTENTS

1. AUCTION TRADING 4

1.1 Basic Matching Rules..... 4

1. Auction Trading

Auction Principle

JSE TradElect™ auctions have two main functions:

- To provide time for the market participants to adjust to changes in market conditions e.g. start of a new day following a price movement
- To maximise participation in price formation

The opening auction and Volatility Auction determines the market price when there is uncertainty about market conditions. The closing auction determines a closing price by enabling maximum participation in price formation.

During auctions all order sizes and persistent order types (market and limit orders) can be entered, ensuring a concentration of liquidity in the order book. All auctions could operate in the same way, whether scheduled or initiated by extensions or volatility events. The market participants are informed when the securities will be called for the auction. Each auction consists of two phases:

1. Call Phase:

   Each auction begins with a call phase. The market participants are able to enter orders as well as modify and delete their existing orders. Each participant firm may enter as many orders to the order book as it wishes.

   Information on the current order situation is provided continually during the call phase with members being able to view best bids and offers as they would normally during continuous trading, as well as being able to see an indicative matching price and volume.

2. Price Determination Phase:

   The auction price is the price with the maximum executable volume. Additionally the minimum surplus, the market pressure and, if necessary, the reference price are taken into account when establishing the auction price.

Figure 1 below, schematically represents the closing auction process and outlines the various phases therein.

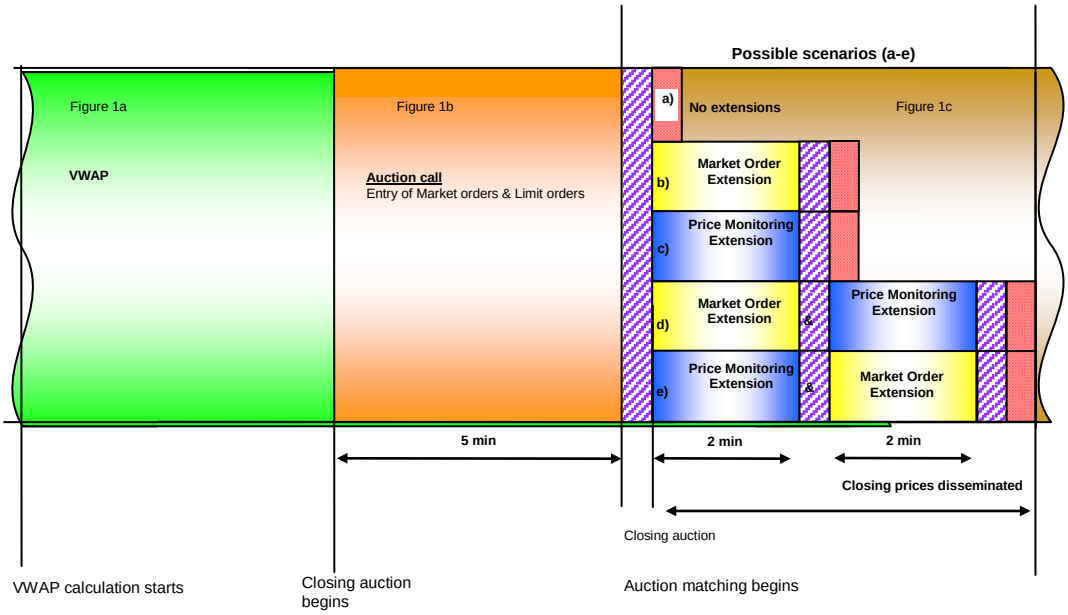

Figure 1: Example of all Closing Auction phases

1.1 Basic Matching Rules

Maximum Execution Principle:
The auction price is determined on the basis of the order book position at the end of the call phase. The auction price is the price with the highest executable order volume for each limit in the order book. Market orders have priority over limit orders to reward liquidity provision.

Example 1: *Maximum Execution Volume*

Figure 2a represents the order book at the end of an auction.

BUY			SELL		
Order	**Volume**	**Price**	**Price**	**Volume**	**Order**
B1	10,000	10550	Market	2,500	S1
B2	5,600	10450	10300	6,900	S2
B3	200	10400	10450	1,000	S3
			10600	200	S4

Figure 2a.

To determine the auction price, it is easier to rearrange the information into a slightly different form as illustrated in figure 2b below.

BUY				SELL		
Order	**Aggregate volume**	**Volume at price**	**PRICE**	**Volume at price**	**Aggregate volume**	**Order**
-		0	Market	2,500		S1
-	0	0	10600	200	10,600	S4
B1	10,000	10,000	10550	0	10,400	-
-	10,000	0	10500	0	10,400	-
B2	15,600	5,600	10450	1,000	10,400	S3
B3	15,800	200	10400	0	9,400	-
-	15,800	0	10350	0	9,400	-
-	15,800	0	10300	6,900	9,400	S2

Figure 2b.

The order book information is transported into the above table, and is contained in the third and fifth columns. The second and sixth columns use the information in third and fifth columns to calculate the volume of buy and sell orders which can be executed at a given price level.

In order for orders to execute, buy orders need sell orders and vice versa. The total executable auction volume is therefore the minimum of the buy and sell executable volumes at any given price level. The above information can therefore be summarised into a further table, figure 2c.

Price	Aggregate volume BUY	Aggregate volume SELL	Auction volume
10600	0	10,600	0
10550	10,000	10,400	10,000
10500	10,000	10,400	10,000
10450	15,600	10,400	10,400
10400	15,800	9,400	9,400
10350	15,800	9,400	9,400
10300	15,800	9,400	9,400

Figure 2c.

The auction price of 10450 would uniquely maximise auction volume, and is the auction price.

The matching upon price determination would be as follows:

BUY				SELL		
Order	**Aggregate volume**	**Volume at price**	**PRICE**	**Volume at price**	**Aggregate volume**	**Order**
-		0	Market	~~2,500~~		S1
-	0	0	10600	200	10,600	S4
B1	10,000	~~10,000~~ ~~7,500~~ ~~600~~	10550	0	10,400	-
-	10,000	0	10500	0	10,400	-
B2	15,600	~~5,600~~ 5,200	10450	~~1,000~~ ~~400~~	10,400	S3
B3	15,800	200	10400	0	9,400	-
-	15,800	0	10350	0	9,400	-
-	15,800	0	10300	~~6,900~~	9,400	S2

Figure 2d.

Part 1: All 2,500 shares of the volume of order S1 match against some of the volume of order B1 (10,000), leaving 7,500 shares associated with order B1.
Part 2: All 6,900 shares of the volume of order S2 match against some of the remaining volume of order B1 (7,500), leaving 600 shares associated with order B1.

Part 3: 600 shares of the volume of order S3 (1,000) match against all the remaining volume of order B1 (600) leaving 400 shares associated with order S3.
Part 4: All remaining 400 shares of the volume of order S3 match against some of the volume of order B2 (5,600), leaving 5,200 shares associated with order B2.

Figure 2e represents the rearranged order book at the end of the auction *after* matching.

BUY			SELL		
Order	**Volume**	**Price**	**Price**	**Volume**	**Order**
B2	5,200	10450	10600	200	S4
B3	200	10400			

Figure 2e.

Minimum Surplus:

Should this process determine more than one limit with the highest executable order volume, the lowest surplus for each limit in the order book is taken into account as a further criterion. The auction price is the price with the highest executable order volume and the lowest surplus for each limit in the order book.

Example 2: *Minimum Surplus*

Figure 3a represents the order book at the end of an auction

BUY		SELL	
Volume	**Price**	**Price**	**Volume**
10,000	10550	MO	2,500
5,600	10450	10300	6,900
200	10400	10400	1,000
		10600	200

Figure 3a

To determine the auction price, it is easier to rearrange the information into a slightly different form as illustrated in figure 3b.

BUY			SELL	
Aggregate volume	**Volume at price**	**PRICE**	**Volume at price**	**Aggregate volume**
	0	MO	2,500	
0	0	10600	200	10,600
10,000	10,000	10550	0	10,400
10,000	0	10500	0	10,400
15,600	5,600	10450	0	10,400
15,800	200	10400	1,000	10,400
15,800	0	10350	0	9,400
15,800	0	10300	6,900	9,400

Figure 3b.

There are now two price levels with the same maximum executable volumes (i.e. 10450 & 10400). We now look at the minimum surplus principle.

Price	**Aggregate volume BUY**	**Aggregate volume SELL**	**Auction volume**	**Auction surplus**
10600	0	10,600	0	-10,600
10550	10,000	10,400	10,000	-400
10500	10,000	10,400	10,000	-400
10450	15,600	10,400	10,400	5,200
10400	15,800	10,400	10,400	5,400
10350	15,800	9,400	9,400	6,400
10300	15,800	9,400	9,400	6,400

Figure 3c

The order surplus is the volume left unexecuted on the order book following the auction execution. A positive sign on the order surplus indicates a surplus on the buy side, while a negative surplus indicates a surplus on the sell side. Since the price 10450 minimises the auction surplus (i.e. 5,200 vs 5,400), this will be the auction price.

Market Pressure:

Should this process determine more than one limit with the highest executable order volume and the lowest surplus for the determination of the auction price, the surplus is referred to for further price determination-:

(1) The auction price is stipulated according to the highest limit if the surplus for all limits is on the buy side (surplus of demand).

(2) The auction price is stipulated according to the lowest limit if the surplus for all limits is on the sell side (surplus of offerings).

Example 3: *Market Pressure*

Figure 4a represents the order book at the end of an auction

BUY		SELL	
Volume	**Price**	**Price**	**Volume**
10,000	10550	MO	2,500
5,600	10500	10300	6,900
1,000	10400	10400	1,000
		10600	200

Figure 4a

To determine the auction price, it is easier to rearrange the information into a slightly different form as illustrated in figure 4b.

BUY			SELL	
Aggregate volume	**Volume at price**	**PRICE**	**Volume at price**	**Aggregate volume**
	0	MO	2,500	
0	0	10600	200	10,600
10,000	10,000	10550	0	10,400
15,600	5,600	10500	0	10,400
15,600	0	10450	0	10,400
16,600	1000	10400	1,000	10,400
16,600	0	10350	0	9,400
16,600	0	10300	6,900	9,400

Figure 4b.

We can see from *Figure 4c* that there are three price levels which maximise executable volumes, and that two of these (10500 and 10450) both minimise auction surplus at 5,200 shares.

Price	Aggregate volume BUY	Aggregate volume SELL	Auction volume	Auction surplus
10600	0	10,600	0	-10,600
10550	10,000	10,400	10,000	-400
10500	15,600	10,400	10,400	5,200
10450	15,600	10,400	10,400	5,200
10400	16,600	10,400	10,400	6,200
10350	16,600	9,400	9,400	7,200
10300	16,600	9,400	9,400	7,200

Figure 4c.

The third principle applied in such instances is market pressure. Taking either of the two prices would leave an order surplus on the buy side of the order book. This residual buy pressure is likely to cause the price to rise after the auction. To reflect this, the auction algorithm takes the higher of the two limits, thus yielding an auction price of 10500.