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Introduction to Paradoxically Rejected Blocks

1. Executive summary

For classic blocks, a paradoxically-rejected block (PRB) is a rejected block which is in the money regarding published prices.

For linked blocks, a child block is PRB when it is in the money and its parent is accepted. A rejected in-the-money child block is not PRB if its parent is rejected, whether the family is in the money or not.

For exclusive blocks, when all the blocks of the group are rejected and some are in the money, only the block with the highest deltaP is PRB.

- A rejected in-the-money exclusive block is not PRB if another block of the group is accepted.
- A rejected in-the-money exclusive block is not PRB if another block of the group is rejected and has a greater deltaP.

For loop blocks, none of the blocks within a loop family can be a PRB. From an algorithmic perspective, loop blocks are modeled as linked blocks that are connected through a parent-child relationship. If one block is rejected, the entire family is rejected, and no block is marked as PRB.

2. Introduction

This document is to briefly explain details behind the determination of "Paradoxically Rejected Blocks" for Block Orders.

In the Electricity Market world, there are two general terms: "Paradoxically Rejected Blocks" and "Paradoxically Accepted Blocks".

As an introductory the explanation of both general terms "Paradoxically Rejected Blocks" and "Paradoxically Accepted Blocks" are briefly explained.

- **Paradoxically Rejected Block:** A block order could be "Rejected" even though if it is "In the Money" regarding published prices which is called "Paradoxically Rejected Blocks (PRB)".
- **Paradoxically Accepted Block:** On the other hand, a block could be "Accepted" even though it is "Out of the Money" which is called "Paradoxically Accepted Blocks". This occurs when a block order has children blocks the executions of which yield gains that compensate for the loss.

    In such case it is tagged as "PAB with Child" in ETS.

The below formula is used to determine $DeltaP_b$ which is the main input parameter to determine whether the given block order is "In the Money" or not.

$$DeltaP_b = \frac{\sum_{h \in H} q_{bh} \cdot (p_b - MCP_h)}{\sum_{h \in H} |q_b^h|} \quad |$$

For Linked Family, to determine the welfare for a linked family (i.e. Moneyness of the whole family) the below formula is considered

$$\sum_{b \in Li} AAR_b \sum_{h \in H} q_{h,b,a} * (p_{b,a} - MCP_h)$$

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$$DeltaP_i = \frac{}{\sum_{b \in L_i} AAR_b \sum_{h \in H} |q_{h,b,a}|}$$

- ○ If DeltaP > 0 then block b is "In the Money"
- ○ If DeltaP = 0 then block b is "At the Money"
- ○ If DeltaP < 0 then block b is "Out of the Money"

Where

- $h \in H$ Set of periods
- $b \in B$ Set of block orders
- q_{bh} Submitted Quantity of block b for period h; convention: purchase quantity is positive, sale quantity is negative
- p_b Limit price of block b
- MCP^h Market clearing price for period h
- AAR_b actual acceptance ratio of the bth block
- L_i block *b* belonging to the linked family *Li*

The following chapters of the document gives an overview of various conditions for each block type (C01, C02, C04, C88) to determine PRB status and other possible status that can be displayed within ETS.

3. Case 1: Classic Block Order (C01)

Block type	Block Status	PRB Status	Additional Remarks
C01	In the Money and Accepted	No	
C01	In the Money and Rejected	PRB	
C01	At the Money and Rejected	No	
C01	At the Money and Accepted	No	
C01	Out of the Money and Rejected	No	
C01	Out of the Money and Accepted	PAB with Child	This is possible only if the C01 block is the parent of an executed C02 block

4. Case 2: Linked Family Block Order (C02)

Let us take the basic example of a family with one parent and one child (C01-C02).

Block types	Parent status	Child Status	Child DeltaP	Child PRB Status
C01-C02	Rejected	Rejected	Out of the Money	No
C01-C02	Rejected	Rejected	In the Money	No
C01-C02	Rejected	Rejected	At the Money	No
C02	Accepted	Accepted	In the Money	No
C01-C02	Accepted	Rejected	Out of the Money	No
C01-C02	Accepted	Rejected	At the Money	No
C01-C02	Accepted	Rejected	In the Money	PRB

4.1   Exceptional Cases – Linked Family Block Order

The below section describes some exceptional cases.

• In Euphemia, a child block C02 which is in-the-money but rejected because its parent is rejected is not considered a PRB

4.2   Example: Linked Block Families

Consider the Block Order of Linked Families with a C01 block (out of the money) and a C02 block (in the money):

Linked Family: LF001

Block ID	Block Type	Relation	Moneyness	Status	PRB Status
001	C01	Father	Out of the Money	Rejected	No
002	C02	Child	In the Money	Rejected	No

In the above example,
❼*No blocks in the Linked Families will be tagged as PRB. Because as the Parent (Block 001) is rejected, the child block (002) will also be rejected.*

Consider another block as below:

Linked Family: LF002

Block ID	Block Type	Relation	Linked Block ID	Moneyness	Status	PRB Status
001	C01	Father		In the Money	Accepted	No
002	C02	Child	001	In the Money	Rejected	PRB
003	C02	Child	001	In the Money	Accepted	No

❼*Block = 002 will be tagged as PRB because of the conditions that*

   ○   *Block = 001 (Parent) is "In the Money" and it is "Accepted"*

   ○   *Block = 002 (Child) is "In the Money" and it is "Rejected"*

Consider another block as below:

Linked Family: LF003

Block ID	Block Type	Relation	Linked Block ID	Moneyness	Status	PRB Status
001	C01	Father		In the Money	Accepted	No
002	C02	Child	001	In the Money	Rejected	PRB
003	C02	Child	002	In the Money	Rejected	No

Consider another block as below:

Linked Family: LF004

Block ID	Block Type	Relation	Linked Block ID	Moneyness	Status	PRB Status
001	C01	Father		In the Money	Accepted	No
002	C02	Child	001	Out of the Money	Rejected	No
003	C02	Child	002	In the Money	Rejected	No

5. Case 3: Exclusive Group Block Order (C04)

Let us consider two exclusive blocks A and B of the same group with deltaP(A)>deltaP(B).

Block type	Block Status A	Block Status B	PRB Status A	PRB Status B	Additional Remarks
C04	Out of the Money and Rejected	Out of the Money and Rejected	No	No	
C04	In the Money and Accepted	Out of the Money and Rejected	No	No	
C04	In the Money and Accepted	In the Money and Rejected	No	No	Block B is rejected and block A from the same group is accepted.
C04	In the Money and Rejected	In the Money and Accepted	No	No	Block A is rejected and block B from the same group is accepted even if deltaP(A)>deltaP(B)
C04	In the Money and Rejected	In the Money and Rejected	PRB	No	Only block A is considered PRB as it has the highest deltaP.

5.1   Example 4a: Exclusive Group

Consider the below Block Order which is having C04 blocks:

Block ID	Block Type	Moneyness	DeltaP	Status	PRB Status
001	C04	In the Money	+8	Rejected	No
002	C04	In the Money	+5	Rejected	No
003	C04	In the Money	+4	Accepted	No

In the above example, the situation here is as below:
❼Only one C04 block 003 which is "In the Money" has been accepted in the exclusive group.
❼Blocks (001, and 002) which are "In the Money" are not accepted and none of these blocks are PRBs.

The blocks which are "In the Money" and "Rejected" will not be tagged as PRB in this situation, since, as per Euphemia rule, a block order which is rejected and which is "In the Money" cannot be PRB as another block order from the same exclusive group has been accepted

5.2   Example 4b: Exclusive Group

Consider the below Block Order which is having C04 blocks:

Block ID	Block Type	Moneyness	DeltaP	Status	PRB Status
001	C04	In the Money	+8	Rejected	No
002	C04	In the Money	+10	Rejected	PRB
003	C04	Out of the Money	-5	Rejected	No

In the above example, the situation here is as below:
❼All blocks are "Rejected", two of them are "In the Money"

In this case, only the Block with Maximum DeltaP will be tagged as PR, so Block ID = 002 will be tagged as PRB in ETS

6. Case 4: Loop Family Block Order (C88)

Let us take the basic example of a family with two loop blocks (C88-C88).

Block types	Block 1 status	Block 2 Status	Block 2 DeltaP	Block 2 PRB Status
C88-C88	Rejected	Rejected	Out of the Money	No
C88-C88	Rejected	Rejected	In the Money	No
C88-C88	Rejected	Rejected	At the Money	No
C88-C88	Accepted	Accepted	In the Money	No

7. Annex

7.1 For linked block order

- A child can be rejected although it is "In the money" without being PRB because his parent is "Rejected".
- A child is flagged as PRB only if it is "In the money" and his parent is "Accepted"

7.2 For Exclusive group

- The algorithm may accept any combination of block orders within the exclusive group order as long as the combined actual acceptance ratio (ratio of accepted volume to total block volume) of the exclusive group order is less than or equal to 1.
- In an exclusive group of blocks, a maximum of one block can be executed if all blocks have MAR = 1. If several blocks in the group are in the money, the one which optimizes the total welfare is executed. The other blocks are not executed and not considered as Paradoxically rejected blocks.
- If no block in the exclusive group of block is executed though at least one block was in the money, only one block in the group with maximum DeltaP is considered as Paradoxically Rejected Block (PRB).