Market simulation: HYDR case study

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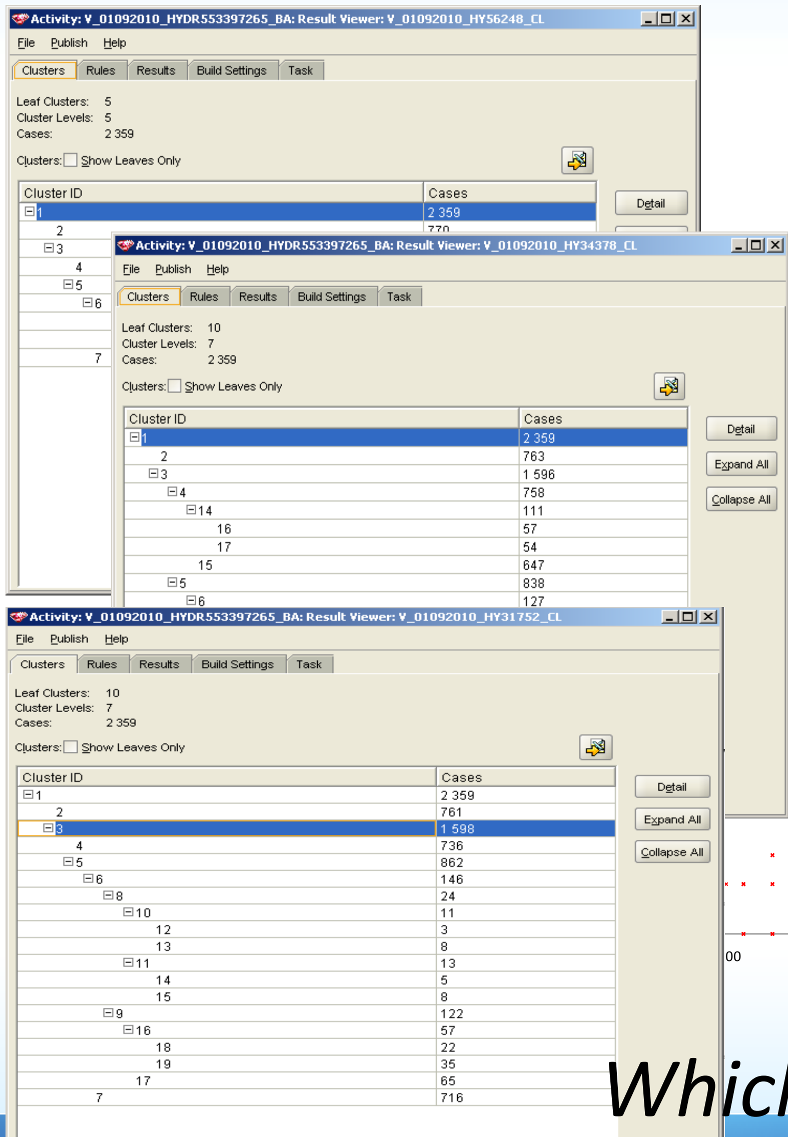
HYDR

RusHydro is the biggest Russian hydro-generating company and the second biggest in the world in terms of installed capacity.

HYDR is referred to be the blue chip. During September, 2010 :

- on average 18100 orders arrived daily,
- 2 billion stocks daily were bought and sold,
- $2.1 billion turnover for a month.
- Totally 16892 market participants appeared to trade.

Market microstructure : primary analysis


Activity: V_01092010_HYDR553397265_BA: Result Viewer: V_01092010_HY56248_CL

File Publish Help

Clusters Rules Results Build Settings Task

Leaf Clusters: 5
Cluster Levels: 5
Cases: 2 359

Clusters: Show Leaves Only

Cluster ID	Cases
1	2 359
2	770
3	
4	
5	
6	
7	

Detail

Activity: V_01092010_HYDR553397265_BA: Result Viewer: V_01092010_HY34378_CL

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Clusters Rules Results Build Settings Task

Leaf Clusters: 10
Cluster Levels: 7
Cases: 2 359

Clusters: Show Leaves Only

Cluster ID	Cases
1	2 359
2	763
3	1 596
4	758
14	111
16	57
17	54
15	647
5	838
6	127

Detail
Expand All
Collapse All

Activity: V_01092010_HYDR553397265_BA: Result Viewer: V_01092010_HY31752_CL

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Clusters Rules Results Build Settings Task

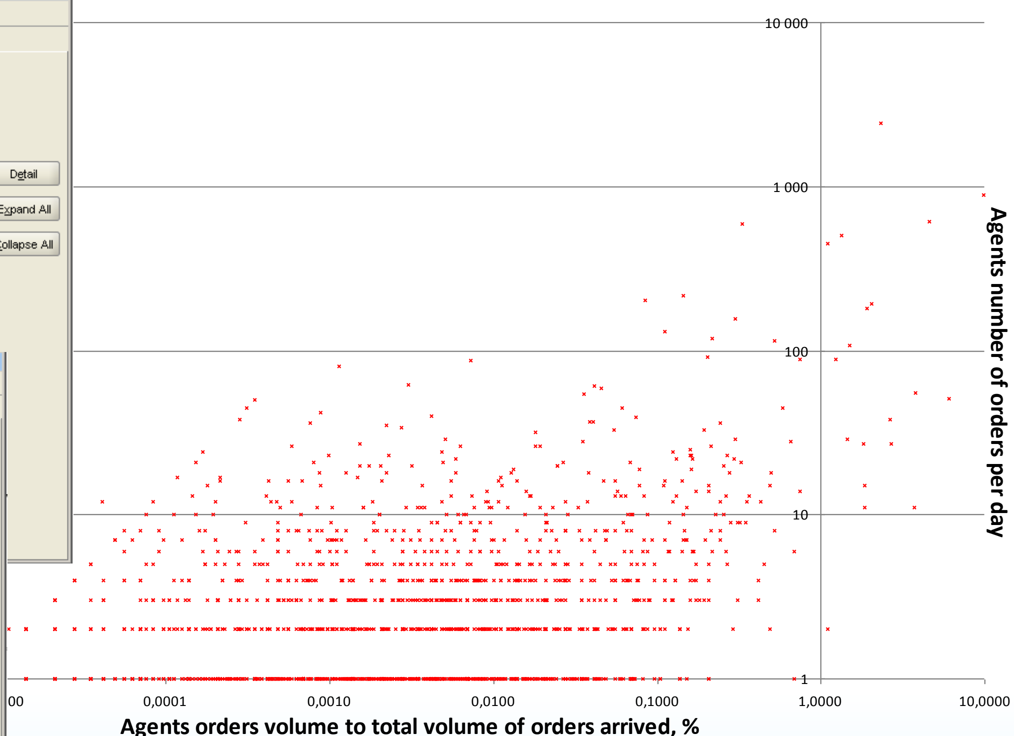
Leaf Clusters: 10
Cluster Levels: 7
Cases: 2 359

Clusters: Show Leaves Only

Cluster ID	Cases
1	2 359
2	761
3	1 598
4	736
5	862
6	146
8	24
10	11
12	3
13	8
11	13
14	5
15	8
9	122
16	57
18	22
19	35
17	65
7	716

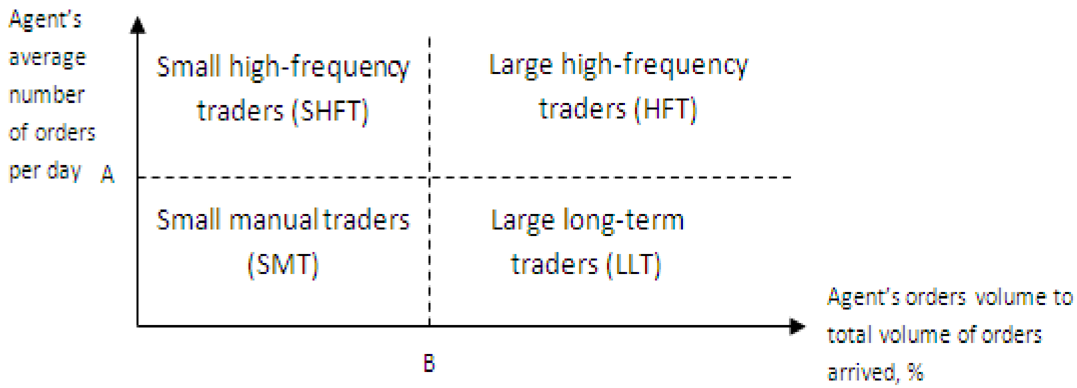
Detail
Expand All
Collapse All

Scatter plot on September, 22, 2010



Which one is correct?

HYDR: market microstructure map



Agents type	Number of agents (% of total)	Average orders intensity per agent per day	Average share of orders generated per agent per day	Total share of orders generated per cluster
HFT	16 (0,09%)	336,5	2,03%	32,45%
SHFT	69 (0,41%)	59,8	0,11%	7,30%
LLT	4 (0,02%)	9,5	1,52%	6,08%
SMT	16803 (99,48%)	0,5	0,003%	54,16%

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Techniques applied

- Agents clusters modeling
- Econometrics for decision making functions

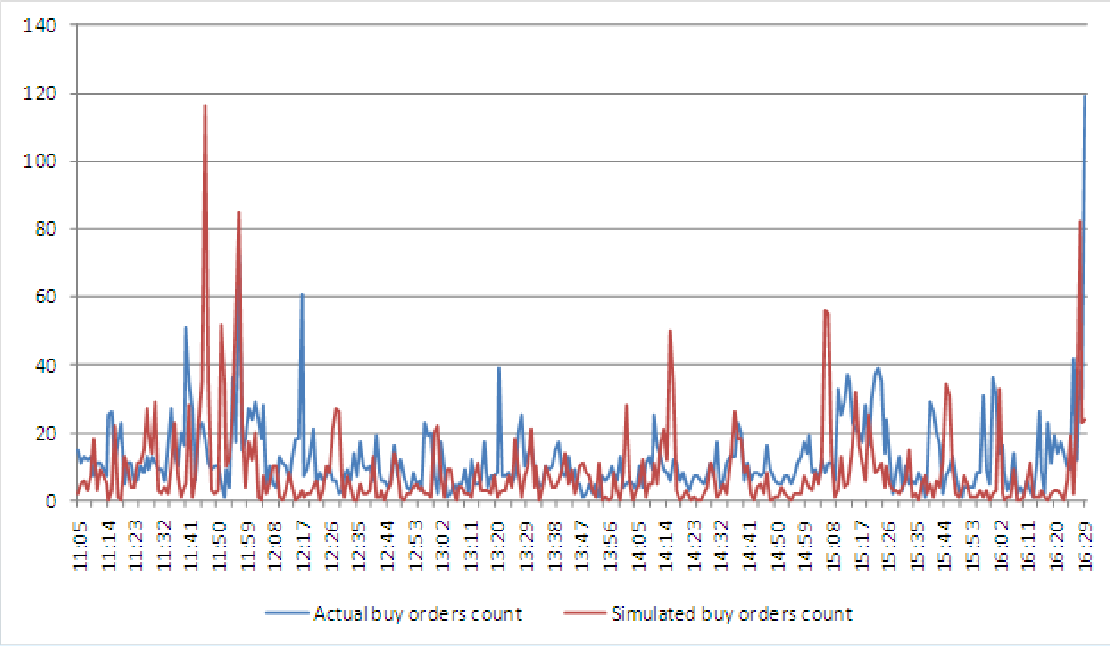
  For order placement:
  - Linear regressions for HFTs and SHFTs,
  - Logit regressions for LLTs
- Monte-Carlo simulation
  - Exponential, Cauchy, Log-normal distributions.
  - Gaussian copula

Order parameters : HFTs and SHFTs

- Dividing day session into subsessions;
- Using AR-processes to imitate order placement intensity

$$CNT_t = 1.61 + 0.504 \cdot CNT_{t-1} + 0.115 \cdot CNT_{t-5}$$, R^2 = 31%, sell side, subsession 11.00 – 16.30

$$CNT_t = 1.89 + 0.601 \cdot CNT_{t-1} + 0.119 \cdot CNT_{t-5}$$, R^2 = 42%, buy side, subsession 11.00 – 16.30



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Order parameters: LLTs

- Logistic regression for decision on order placement,
- Linear regression for price-quantity order parameters

$$L_t = \frac{1}{1 + \exp(-5.58 + 2.71 BUY\_SH_{t-1} + 0{,}00000013\ 1 \cdot MVOL_{t-1})}$$, R^2 = 16,7%, buy side

$$L_t = \frac{1}{1 + \exp(-5.91 + 2.808 \cdot SELL\_SH_{t-1} + 0{,}00000012\ 3 \cdot MVOL_{t-1})}$$, R^2 = 18%, buy side

$$BUYVOL_t = -3749277\ .69 + 7510510\ .3 \cdot BUY\_SH_{t-1} + 0.165 \cdot MVOL_{t-1}$$, R^2 = 27%

$$SELLVOL_t = -1672266\ .3 + 4997988 \cdot SELL\_SH_{t-1} + 0.2511 \cdot MVOL_{t-1}$$, R^2 = 36,7%

$$BUYP_t = 0.998 \cdot MPRICE_{t-1}$$, R^2 = 74,3%

$$SELLP_t = 0.089 + 0.943 \cdot MPRICE_{t-1}$$, R^2 = 70,3%

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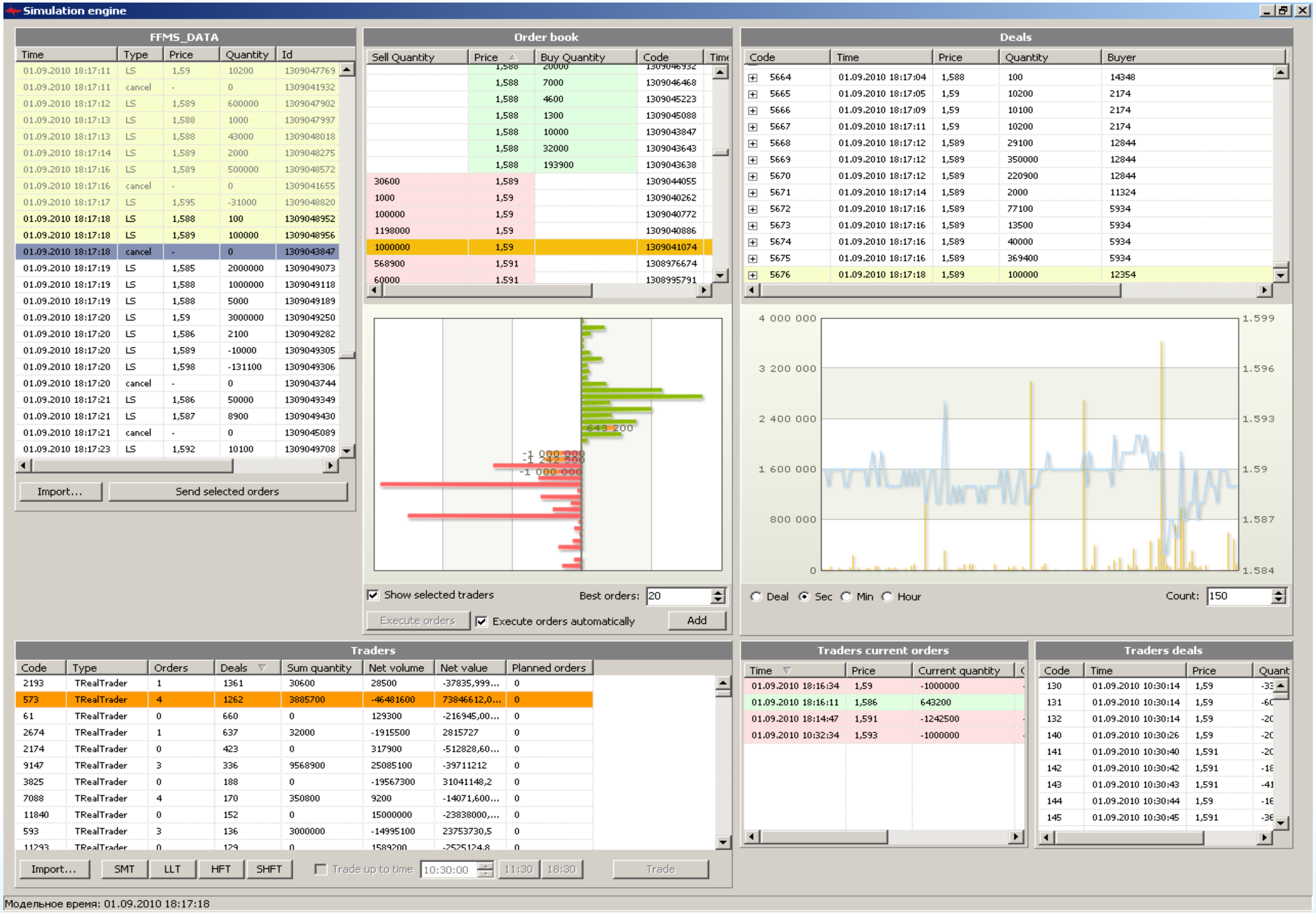
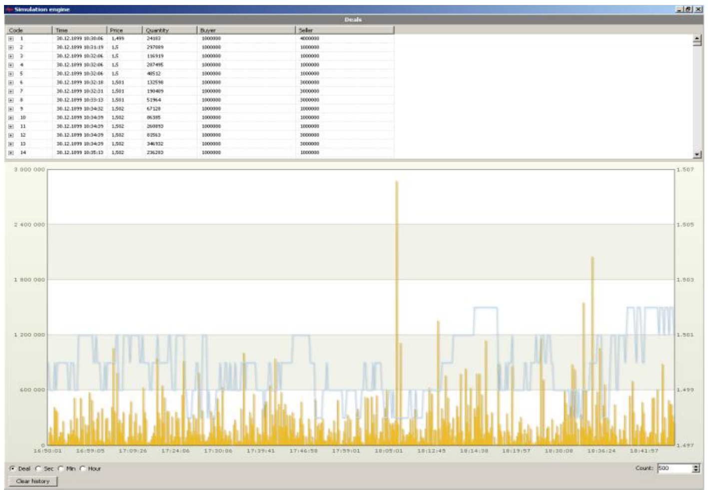
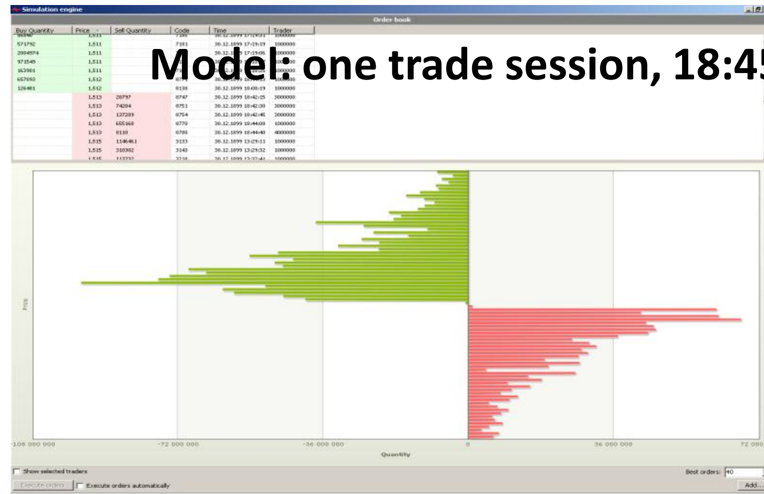
Simulation Engine

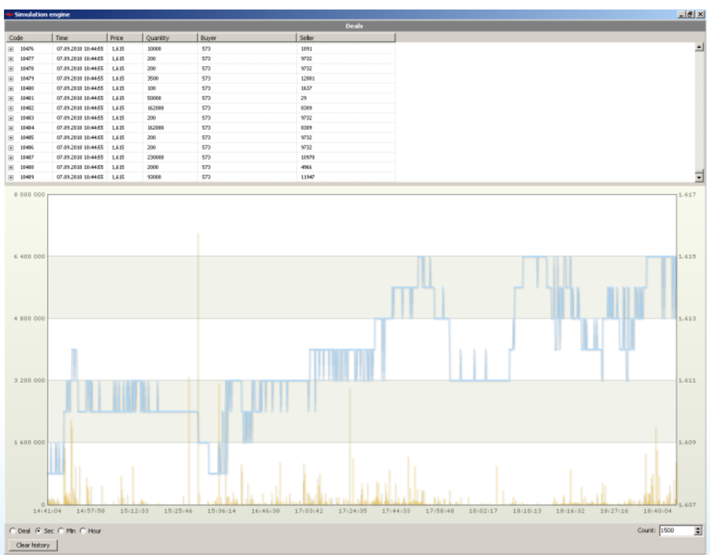


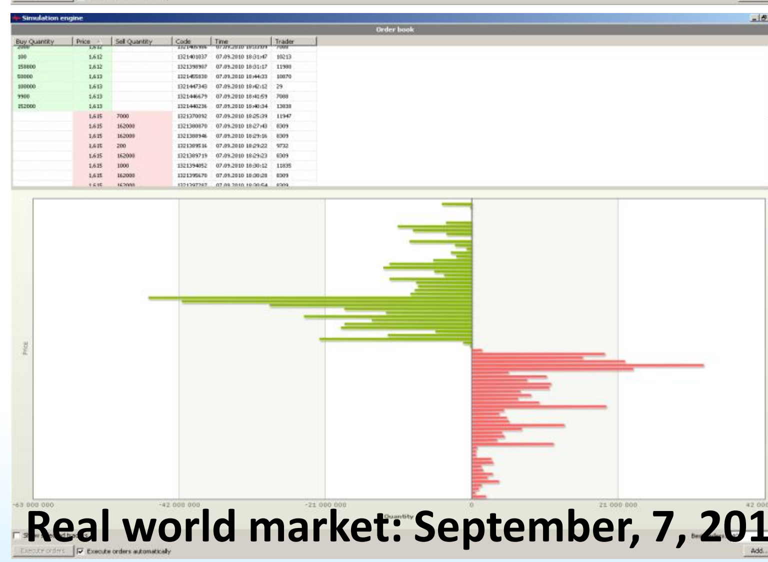
Model results comparing to real world market





Model: one trade session, 18:45

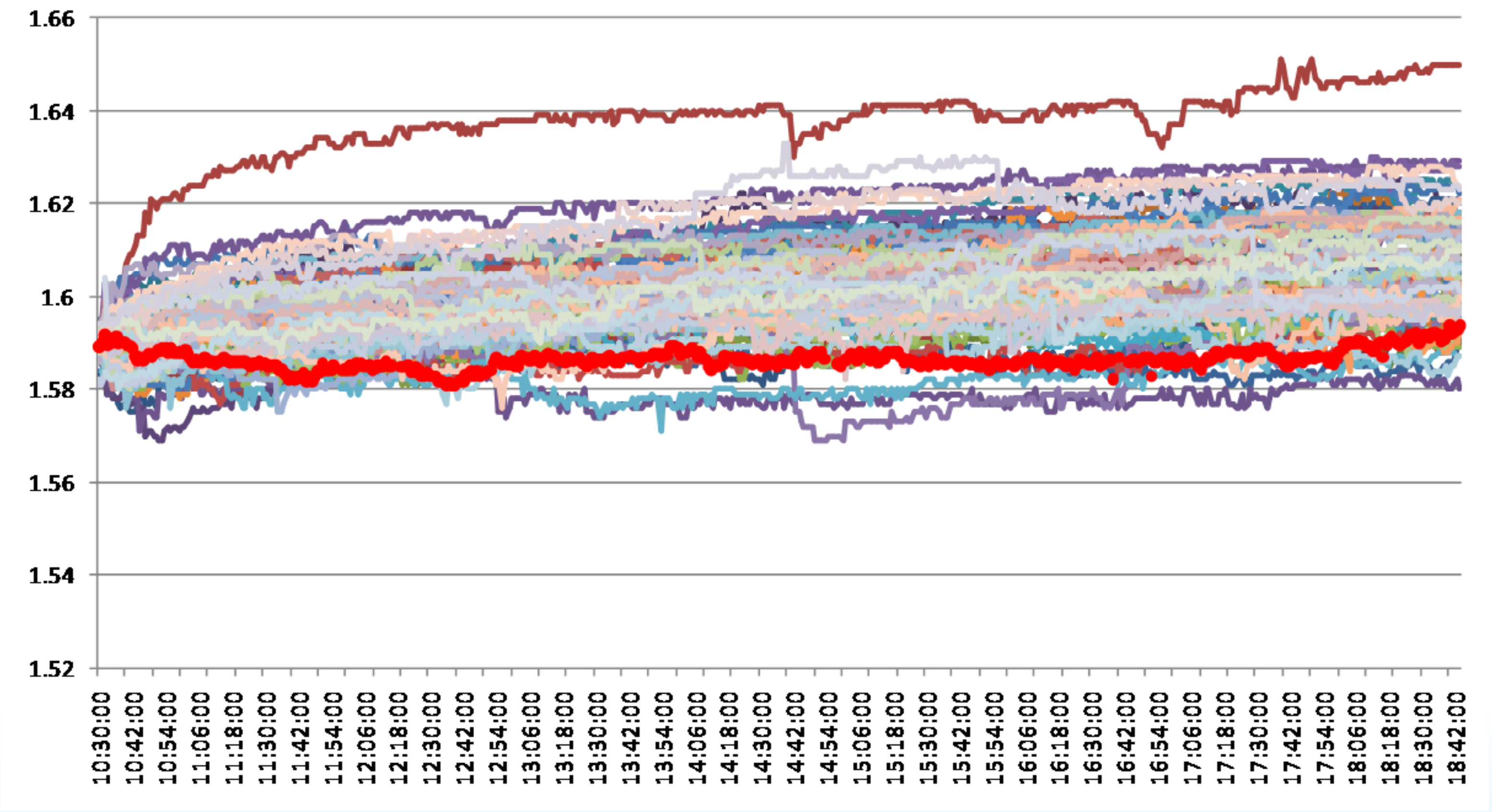




Real world market: September, 7, 2010 18:45

Model results comparing to real world market

Price dynamics



What's next?

- Detailing clusters,
- Turn from sub clusters to agents level,
- Implementing direct agents interaction,
- Further decision making functions calibration…

Thank you!

Questions?

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