Impact methodology

Version 1.0

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Revision History

Name	Date	Reason for changes	Version
Andrey Lubimov	31/01/2007	Fully detailded version	1.0

1 Introduction

This paper describes market impact model based on Bikker's one (see [1]). In more details we make point of auxiliary variables' definition, impacts' definition, general form of our model, optimal choise of regressors. Also we give results obtained on Euronext data for 2 indices (CAC40 and SBF80). We obtained good R^2 and several graphics illustrated good forecast ability of our model.

2 Auxiliary functions and notations

We use the following notation for different functions:

$$\mathbf{F}[\alpha_1, \alpha_2, \ldots, \alpha_n; x_1, x_2, \ldots, x_k; Gr] : Gr \to \mathbb{R}^1$$

Here $\alpha_1, \alpha_2, \ldots, \alpha_n$ are some real parameters, $x_1, x_2, \ldots, x_k$ are some time series, Gr is corresponding time grid.

Also, to simplify formulas we define:

- $I(w, t; Gr) = \{i : t_i \in Gr, t - w < t_i <= t\}$ - the set of lagged indices within some window with size w ($t \in Gr$).
- $N(w, t; Gr) = |I(w, t; Gr)|$.

2.1 Trend related functions and notations

- **Moving average**

$$MA[w; x; Gr](t) = \frac{1}{N(w, t; Gr)} \sum_{I(w,t;Gr)} x_i$$

- **Weighted moving average**

$$WMA[w; v, x; Gr](t) = \frac{\sum_{I(w,t;Gr)} x_i v_i}{\sum_{I(w,t;Gr)} v_i}$$

- **Exponentially weighted moving average**

  For heterogeneous time-series we can use recurrent formulas of exponential weighted moving average. So for interested time moment t_i EMA value is presented from recurrent formula

$$\begin{aligned} EMA[\alpha; x; Gr](t_i) &= \exp^{-\alpha(t_i - t_{i-1})} EMA[\alpha; x; Gr](t_{i-1}) \\ &+ (\nu - \exp^{-\alpha(t_i - t_{i-1})}) x_{i-1} + (1 - \nu) x_i \end{aligned} \quad (1)$$

5.2.2 Testing data

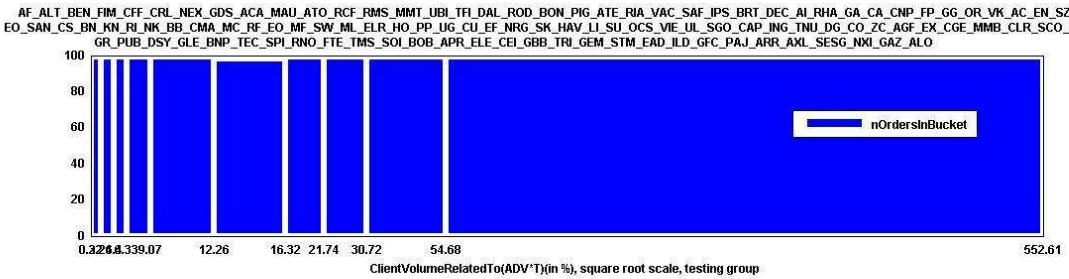
We use orders from testing data to check stability of our model: we calculate theoretical impact using already obtained model parameters and compare it with observed impact in terms of R^2 or graphically. Testing data contains 989 after applying filters mentioned above. We have the following R^2 values:

- $\mathrm{R}^2(J, X_J\lambda) = 0.1670$
- $\mathrm{R}^2(I, X_I\mu) = 0.1159$
- R^2 calculated for both impacts equals 0.1327

We made several graphics illustrated difference between theoretical and observed impacts depending on some another variable-criterion. In more details we divide total set of orders on buckets according to value of criterion(we consider quantiles of criterion with the purpose to obtain equal number of orders in each bucket) and calculate mean values in each bucket separately.

As a result we obtained the following graphics:

- Theoretical vs. observed realized impacts with theoretical impact as a criterion.(see Figure 1)
- Theoretical vs. observed realized impacts with $X/\left(ADV_{i_{order}} \cdot T\right)$ as a criterion.(see Figure 2)
- Theoretical vs. observed permanent impacts with theoretical impact as a criterion.(see Figure 3)
- Theoretical vs. observed permanent impacts with $X/\left(ADV_{i_{order}} \cdot T\right)$ as a criterion.(see Figure 4)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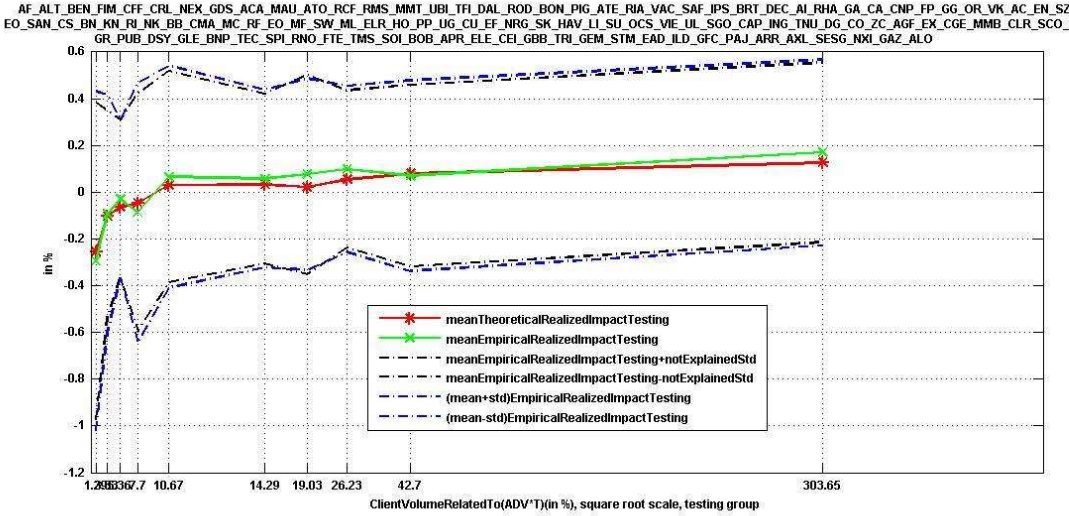
nOrdersInBucket
0
20
40
60
80
100
12.26
16.32
21.74
30.72
54.68
552.61
ClientVolumeRelatedTo(ADV^T)(in %), square root scale, testing group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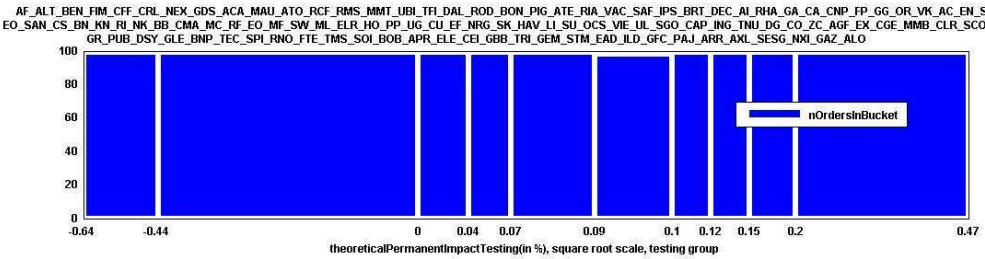
GR_PUB_DSY_GLE_BNP_TEC_SPI_RNO_FTE_TMS_SOI_BOB_APR_ELE_CEI_GBB_TRI_GEM_STM_EAD_ILD_GFC_PAJ_ARR_AXL_SESG_NXI_GAZ_ALO
meanTheoreticalRealizedImpactTesting
meanEmpiricalRealizedImpactTesting
meanEmpiricalRealizedImpactTesting+notExplainedStd
meanEmpiricalRealizedImpactTesting-notExplainedStd
(mean+std)EmpiricalRealizedImpactTesting
(mean-std)EmpiricalRealizedImpactTesting
in %
-1.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
10.67
14.29
19.03
26.23
42.7
303.65
ClientVolumeRelatedTo(ADV^T)(in %), square root scale, testing group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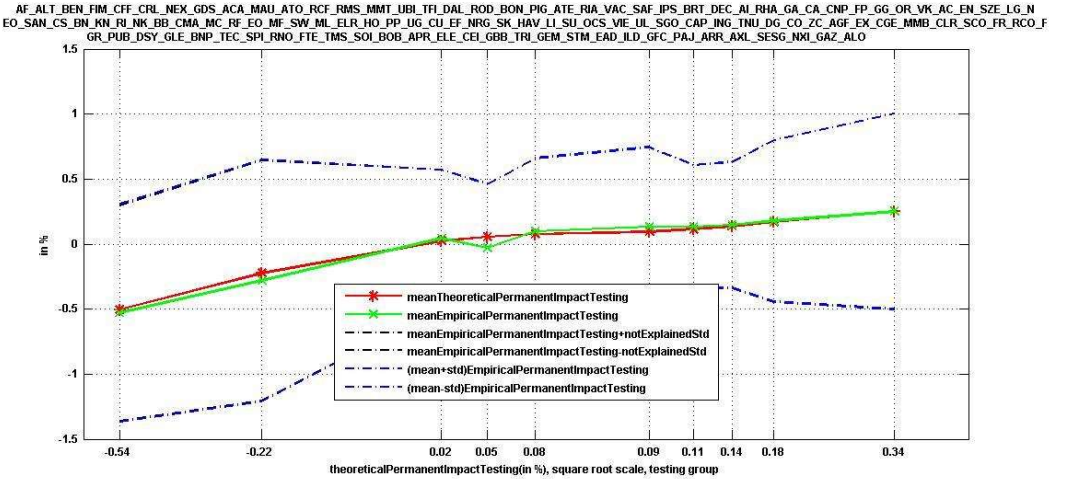
GR_PUB_DSY_GLE_BNP_TEC_SPI_RNO_FTE_TMS_SOI_BOB_APR_ELE_CEI_GBB_TRI_GEM_STM_EAD_ILD_GFC_PAJ_ARR_AXL_SESG_NXI_GAZ_ALO
nOrdersInBucket
0
20
40
60
80
100
-0.64
-0.44
0
0.04
0.07
0.09
0.1
0.12
0.15
0.2
0.47
theoreticalPermanentImpactTesting(in %), square root scale, testing group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meanTheoreticalPermanentImpactTesting
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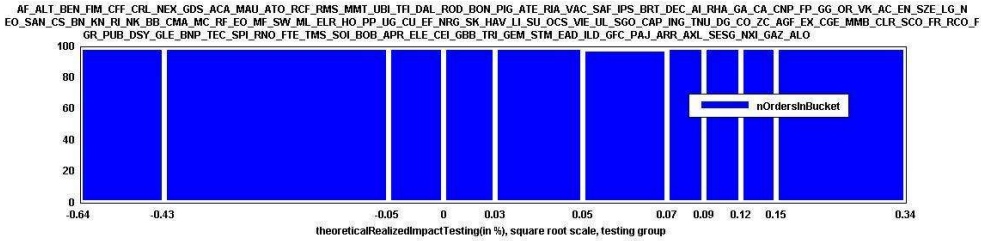
meanEmpiricalPermanentImpactTesting-notExplainedStd
(mean+std)EmpiricalPermanentImpactTesting
(mean-std)EmpiricalPermanentImpactTesting
in %
-1.5
-1
-0.5
0
0.5
1
1.5
-0.54
-0.22
0.02
0.05
0.08
0.09
0.11
0.14
0.18
0.34
theoreticalPermanentImpactTesting(in %), square root scale, testing group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GR_PUB_DSY_GLE_BNP_TEC_SPI_RNO_FTE_TMS_SOI_BOB_APR_ELE_CEI_GBB_TRI_GEM_STM_EAD_ILD_GFC_PAJ_ARR_AXL_SESG_NXI_GAZ_ALO
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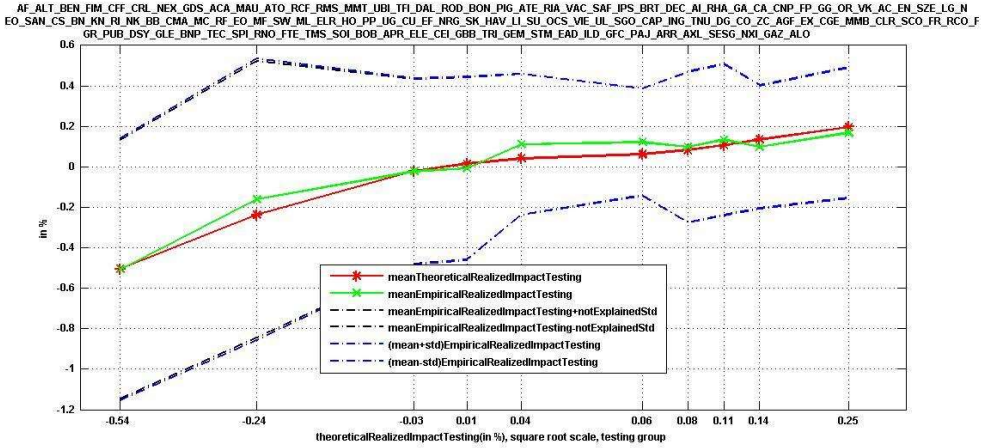
theoreticalRealizedImpactTesting(in %), square root scale, testing group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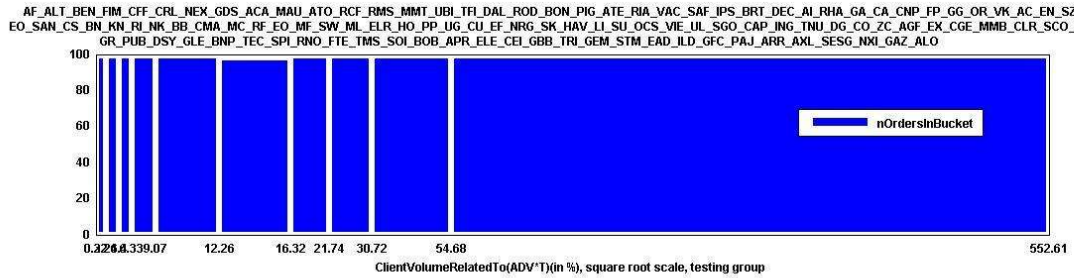
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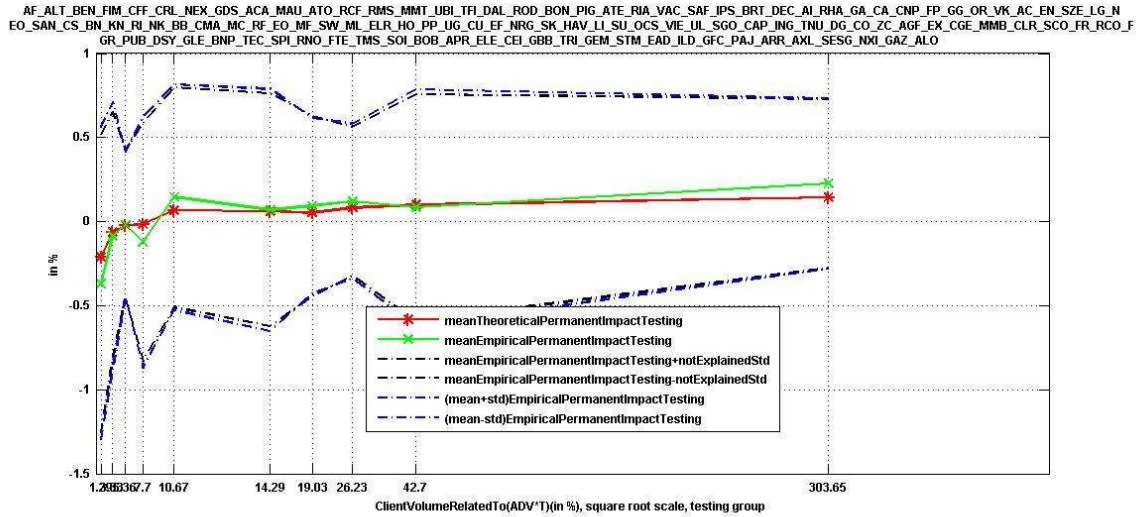
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