Proving the Relation between Stock and Interbank Markets: The Bahrain Stock Exchange

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Proving The Association Between Stock Market And Interbank Lending Market Parameters: The Bahrain Stock Exchange

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Abstract

The present paper deals with further analysis of the relationship between the interbank loan rateon the one hand and the volume of investment and the amount of stocks tradable on the stock exchange on the other hand, as corroborated by calculations performed on Bahrain Stock Exchange data[2].

Keywords: interbank credit market, equity market, stock market, speculations, trading volumes, BSE

JEL Classification: G12, G14, G17, G21

1. Introduction

There has been a number of studies into the association between interbank loan rates and stock market parameters(M.Yandiev, 2011; M.Yandiev, A.Pakhalov, 2013), providing both the detailed theoretical rationalisation for such an association and its practical corroboration based on calculations performed on the data provided by the Moscow Stock Exchange. The present paper crosschecks M. Yandiev's formula explicating the association by applying it to the Bahrain Stock Exchange.

The formula itself is as follows:

$$u = I * R * \frac{1}{365} * \frac{1}{U}$$

where

- **I** is the volume of speculative investments;
- **R** is the interest rate on overnight interbank loans, in fractions;
- **U** isthe total amount of stocks involved in deals;
- **u** isthe mean loss per deal a trader can allow aiming to close the trading day in the black (logically a constant)

The formulacan be regarded as adequate as long as **u**shows little volatility over a significant length of time.

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Compared to the prior research, the present study goes on to calculate **u** through a number of different approaches. This was done to check the practicability of using each approach and find the one producing more accurate results. Also it should be noted that the data series included isolated instances of excessive surges in trading volumes, possibly distorting the theoretical model's resulting figures. This called for cross-checking the two approaches' results, the one including the irregularities and the one excluding them.

2. Description of the data

The raw data, as indicated above, came from the figures provided by the Bahrain Stock Exchange and the Reuters news agency:

- Total amount of funds deposited in BSE, in MM (**I**, see Appendix 1);
- Amount of stocks deposited in BSE, pcs (**U**, see Appendix 2);
- Fraction of stocks in the total volume of stock trading (alternative calculation of **U**, see Appendix 6);
- BSE overnight interbank loan rate (**R**, see Appendix 3).

3. First approach:proving the hypothesis through calculating standard deviation of *u*

The projected characteristics of **u** were proved through calculating its standard deviation. A number of methods of calculating it was employed for greater precision: with absolute and relative **u** deviations, as well as using a logarithmic function (see Appendix 11).

Moreover, given the surges in daily trading observed throughout the year (on 22.05, 14.06, 20.06, 24.06, and 19.11) (see Appendix 1), their impact on the resulting figures had to be assessed. To that end a second calculation of standard deviation of **u** was carried out excluding these anomalies.

The results were:

1) Calculating the standard deviation of **u** usingitsabsolutevalues (in both total volume of deposited assets and volume of trading) proved the formula's applicability: **u** stayed within a narrow range of low values. Allowing for an accidental nature of the aforementioned surges in trading, the standard deviation of **u** falls significantly, not exceeding 1% of a security's average value. This agrees with the parameter's low volatility, observed by a narrow range of values on the relevant diagram (see Appendices 5 and 6). Therefore the value of **u** was assumed to be constant (see Appendix 4).
2) Calculating the standard deviation of **u** usingitsrelativevalues (in both total amount of deposited stocks and volume of trading) proved unusable. This was due to the fact that, even with a small spread in initial values, however small they themselves may be, their ratio is significantly larger, around 1. This, in turn, far increases their average value and, as a consequence, its standard deviation.
3) Relatively large values of **u** in cases of surges in speculation can be attributed to the accompanying rise in acceptable levels of speculator risk due to an increase in the total value of deposited assets. By the same logic, it can be assumed that increases in **u** before holidays (when there is no trade at the exchange) are due to greater uncertainties and a 'dulling' of risk awareness, or its underestimation.

4) Also noteworthy is the excessive volume of deposited assets, of which only an insignificant number was actively traded. In 100 deposited securities only an average of 4.3 were actively traded, with only 20% of a security's trading value backed by the funds deposited in the exchange (see Appendix 7). This shows an exchange's balanced risk policy: having the securities on offer exceed the demand by several times the number, while zealously attracting the clients' funds.

4. Second approach:proving the hypothesis through regression analysis

The second method of proving the formula's applicability required regression analysis of time series. This enabled ascertaining the relation between the theoretical model's variables, assessing its extent, and also its conformity to the criterion used for evaluating the formula.

The time series input used for the model's 5 variables consisted of 255 observations (one for each working day of 2012, see Appendix 8). The analysis was done for each of the 4 methods of calculating standard deviation. All calculations were made using the Gretl econometrics package.

As regression analysis of time series requires all of the variables to be stationary (Verbeek, 2004, p. 309-310), the first stage of the analysis included an augmented Dickey–Fuller test (ADF) for each of the variables.

Lag length in each case was established based on the Schwarz information criterion (SIC). All the tests were done after de-trending the time series.The results are presented in Appendix 9.

ADF test shown all the variables except **R**to be stationary, enabling using them for regression analysis, while using variable **R** needed it first to be confirmed to be cointegrated.According to Verbeek (MarnoVerbeek, 2004, p. 314-315), in case of cointegrated variables (with first differences ofR being stationary), the theoretical model can yield super consistent estimates, providing for meaningful conclusions.

In this case, in both **u** for the total amount of stocks and **u** for the volume of trading the first differences of **R**are stationary at the 1% level of significance (see Appendix 10). This means that **R** is cointegrated and can be used in the theoretical model.

The results of using regression analysis were:

1) Different methods of calculating standard deviation as one of the variables did not have an impact on the result;
2) Linear regressions using the dependent **u**_small_volwere generallysignificant, with R being significant at the 1% level of significance, and **I** being not significant. Therefore **u** for the volume of trading is heavily dependent on the volume of assets deposited in the exchange, but independent of the interbank loan rate.
3) Linear regressions using the dependent **u**_small_depweregenerallynot significant, with R being significant at the 1% level of significance, and **I** being not significant. Therefore **u** for the volume of trading is heavily dependent on the interbank loan rate, but independent of the volume of assets deposited in the exchange.
4) Coefficients of **R**and **I** were never negative in all of the cases, pointing to their direct relationship with the dependent variables.

5. Conclusions

The result of calculations made in the several approaches have proven that value of **u** remained relatively stable and low throughout the whole of 2012. Moreover, the resulting theoretic econometric model revealed the conjectured relationship between the variables. Therefore, it can be claimed that the formula was able to adequately describe the situation at the Bahrain stock market in 2012.

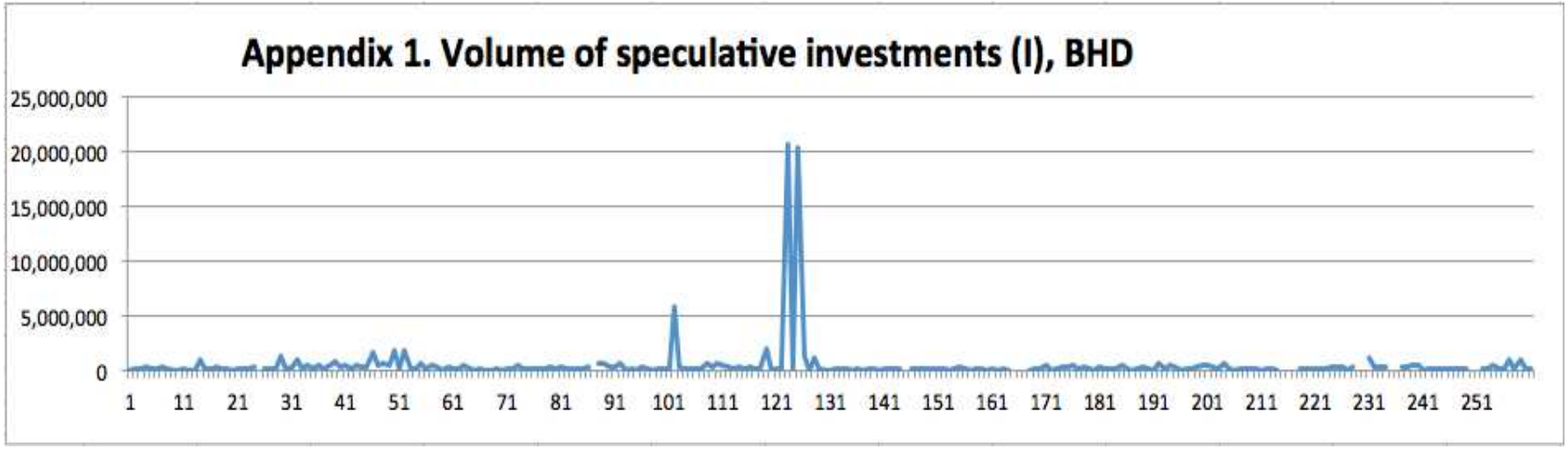
6. Sources

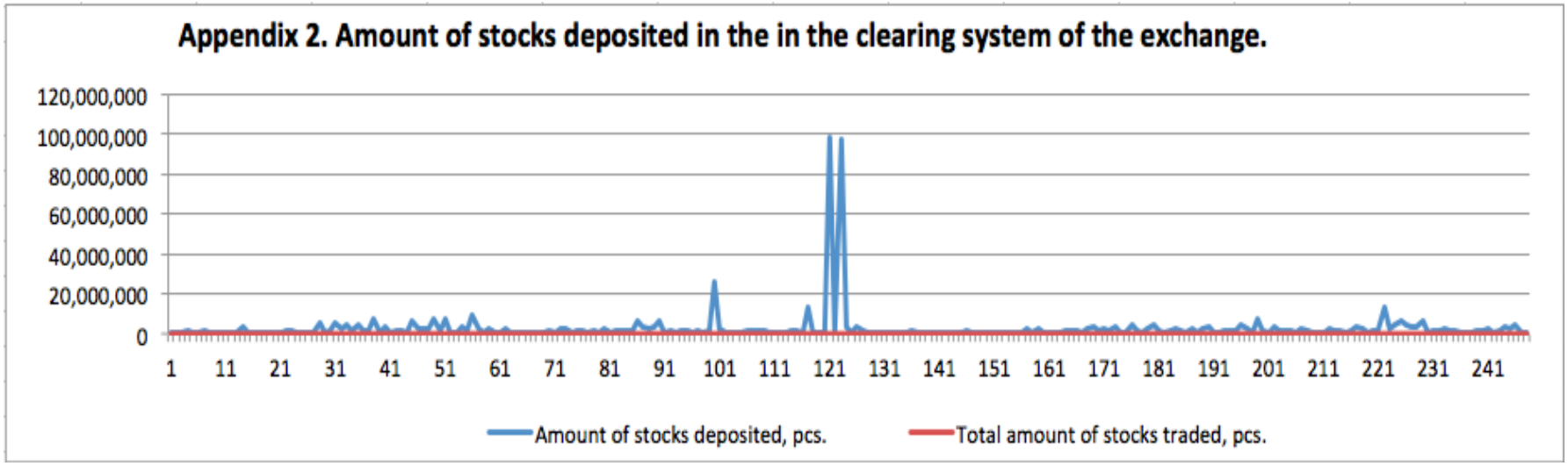
1. Verbeek, Marno. A guide to modern econometrics. 2nd edition. – Chichester^ John Wiley & Sons Ltd, 2004. ISBN 0-470-85773-0

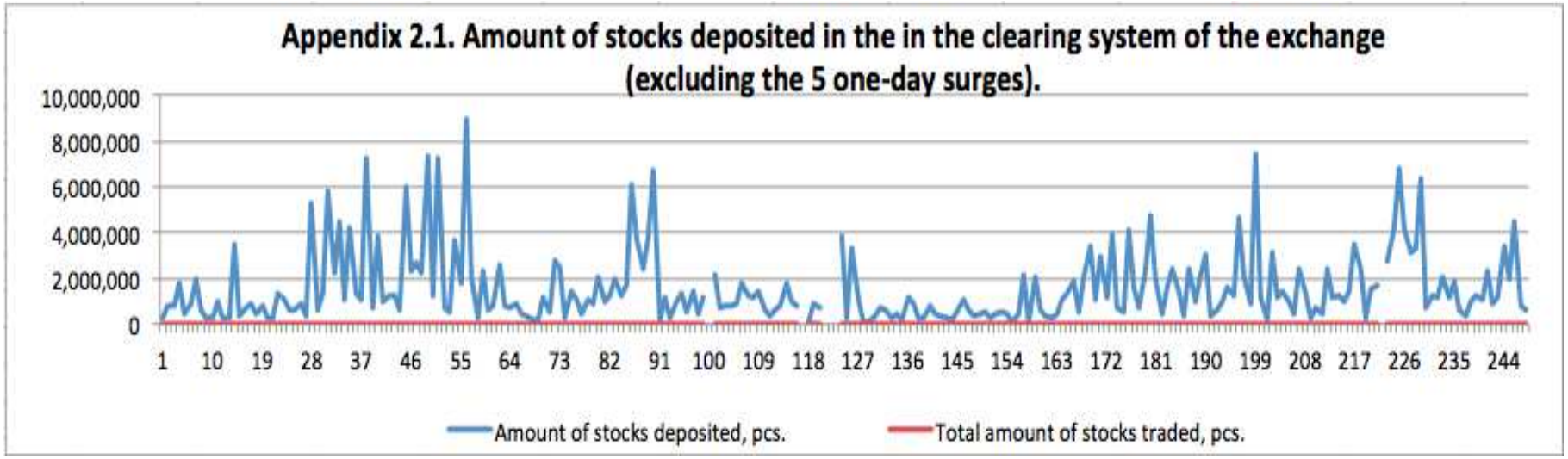
2. Yandiev, Magomet. The Damped Fluctuations as a Base of Market Quotations. Economics and management, № 16, 2011. ISSN 1822-6515. URL: http://ssrn.com/abstract=1919652

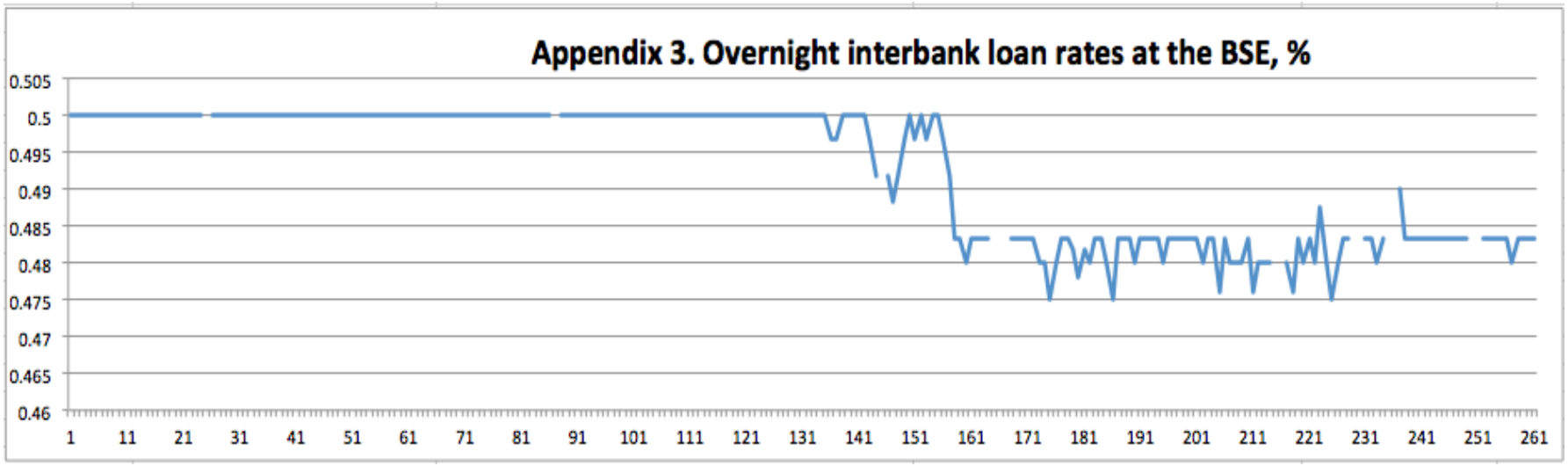
3. Yandiev, Magomet, Pakhalov, Alexander. The Relationship between Stock Market Parameters and Interbank Lending Market: An Empirical Evidence. URL: http://ssrn.com/abstract=2329871

7. Appendices



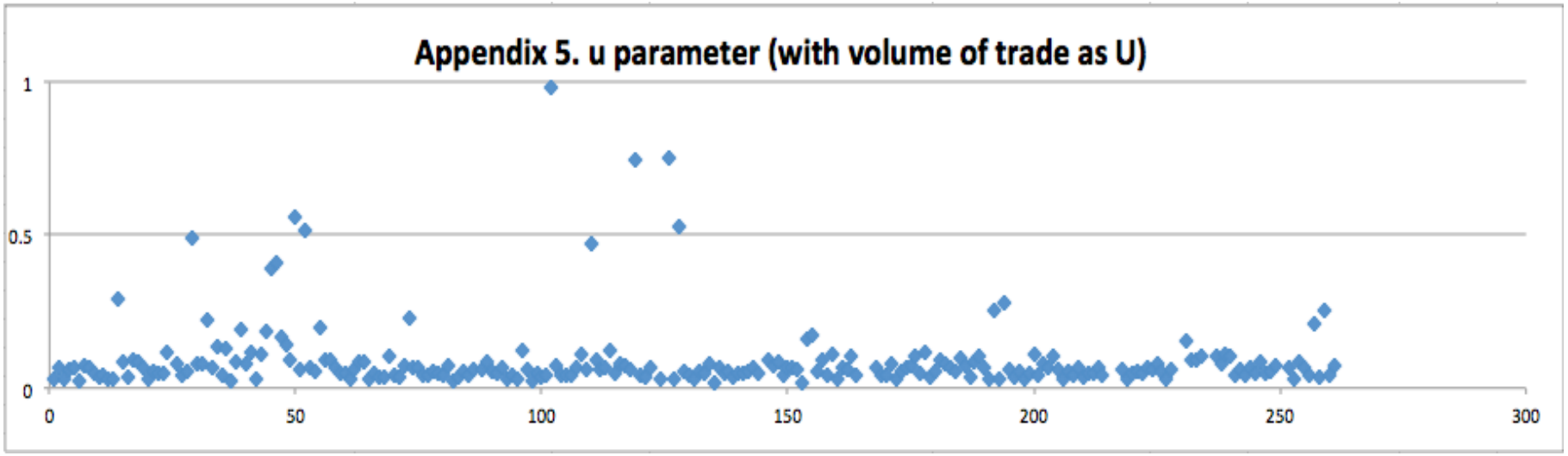


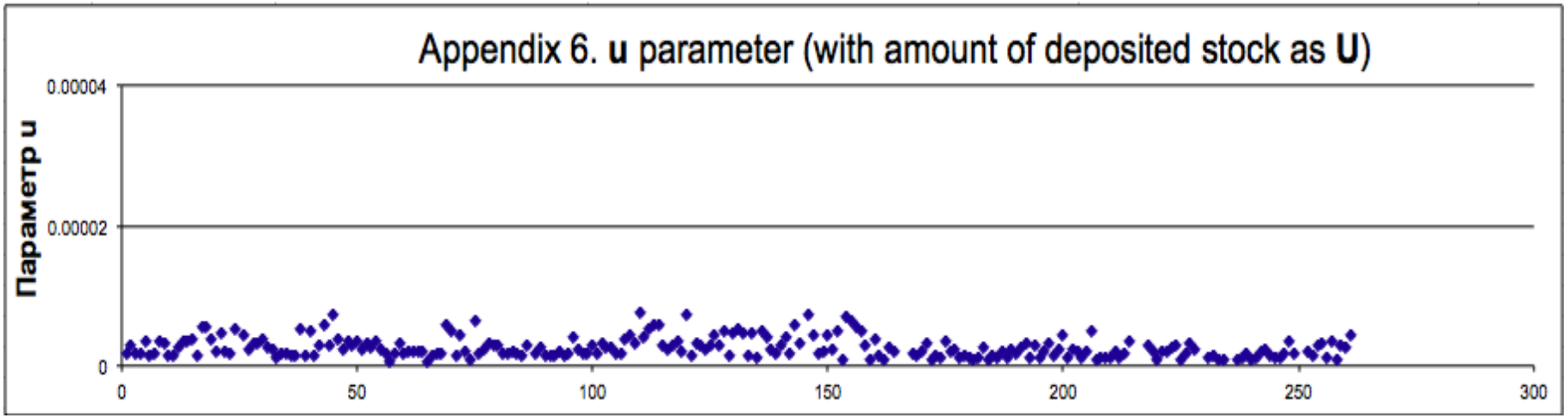

Appendix 2.1. Amount of stocks deposited in the in the clearing system of the exchange (excluding the 5 one-day surges).
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1 10 19 28 37 46 55 64 73 82 91 100 109 118 127 136 145 154 163 172 181 190 199 208 217 226 235 244
Amount of stocks deposited, pcs.
Total amount of stocks traded, pcs.

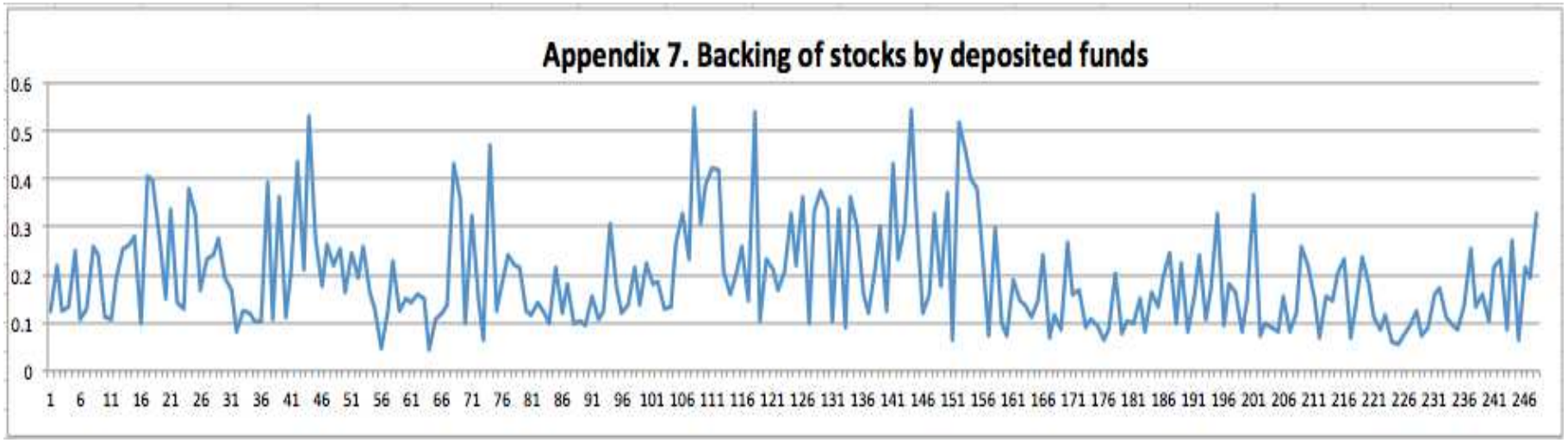

Appendix 3. Overnight interbank loan rates at the BSE, %
0.505
0.5
0.495
0.49
0.485
0.48
0.475
0.47
0.465
0.46
1 11 21 31 41 51 61 71 81 91 101 111 121 131 141 151 161 171 181 191 201 211 221 231 241 251 261

Appendix 4. **u** parameter calculations

u, cents, 2012 r.	With**U**as volume of stocks traded	With**U**as total amount of deposited stocks
Average, cents	0.152540169	0,00000262443
Volatility, cents	0.691299329	0,0000236656
Average security cost, BHD		0.175629031




Appendix 6. u parameter (with amount of deposited stock as U)
Параметр u
0.00004
0.00002
0
0
50
100
150
200
250
300

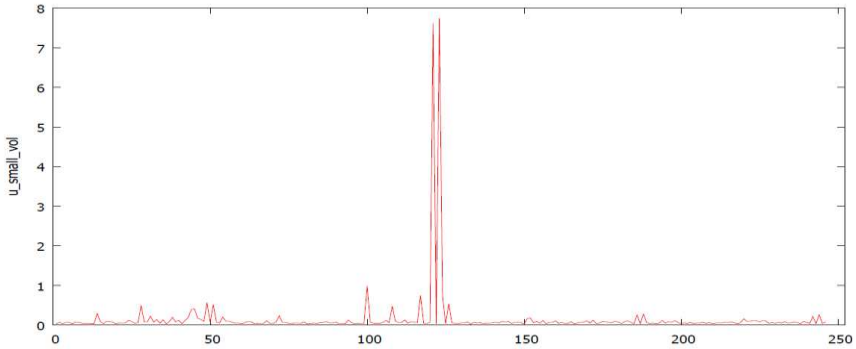

Appendix 7. Backing of stocks by deposited funds
0.6
0.5
0.4
0.3
0.2
0.1
0
1 6 11 16 21 26 31 36 41 46 51 56 61 66 71 76 81 86 91 96 101 106 111 116 121 126 131 136 141 146 151 156 161 166 171 176 181 186 191 196 201 206 211 216 221 226 231 236 241 246

Appendix 8.

Variable name in the theoretical model	Variable name inGretl	Definition
u	u_small_vol	Mean loss per deal (calculated using the volume of trade)
u	u_small_dep	Mean loss per deal (calculated using the amount of stocks deposited)
I	I	Volume of speculative investment (amount of money in the exchange's authorized bank);
R	R	Overnight interbank loan rate

Appendix 9.

9.1. Unit root test for **u_small_vol**



Results of theADF test

Augmented Dickey-Fuller test for u_small_vol

including 3 lags of (1-L)u_small_vol (max was 3)

sample size 242

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + ... + e

1st-order autocorrelation coeff.for e: -0.015

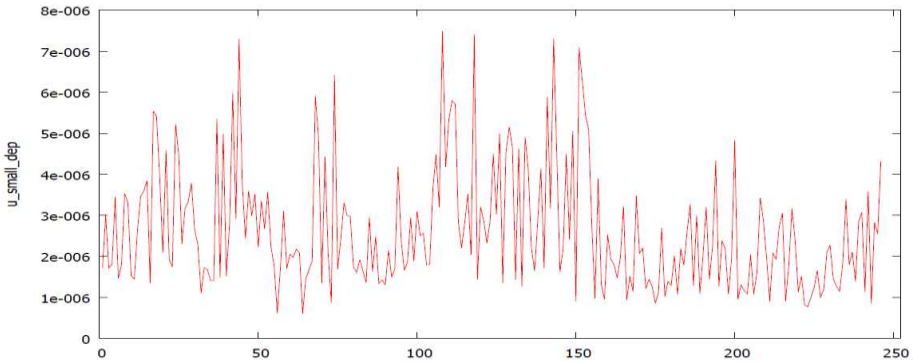
lagged differences: F(3, 237) = 31.556 [0.0000]

estimated value of (a - 1): -0.610872

test statistic: tau_c(1) = -6.91519

asymptotic p-value 5.596e-010

9.2. Unit root test for **u_small_dep**



Results of the ADF test

Augmented Dickey-Fuller test for u_small_dep

including 2 lags of (1-L)u_small_dep (max was 4)

sample size 243

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + ... + e

1st-order autocorrelation coeff.for e: -0.008

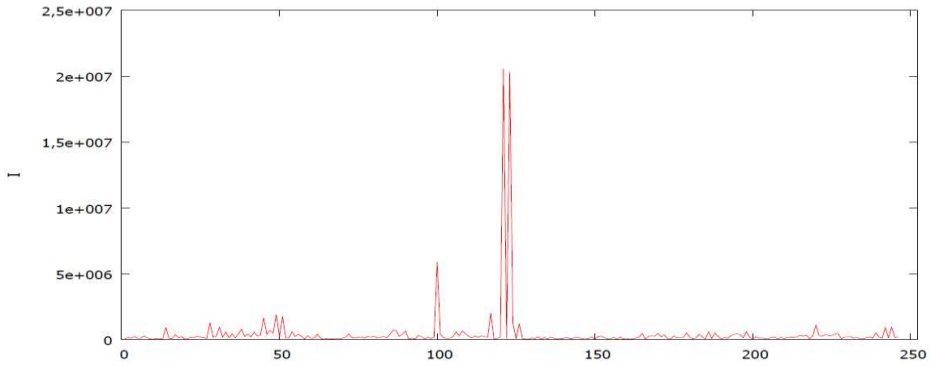
lagged differences: F(2, 239) = 13.798 [0.0000]

estimated value of (a - 1): -0.472213

test statistic: tau_c(1) = -5.51816

asymptotic p-value 1.58e-006

9.3. Unit root test for **I**



Results of the ADF test

Augmented Dickey-Fuller test for I

including 3 lags of (1-L)I (max was 4)

sample size 242

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + ... + e

1st-order autocorrelation coeff.for e: -0.010

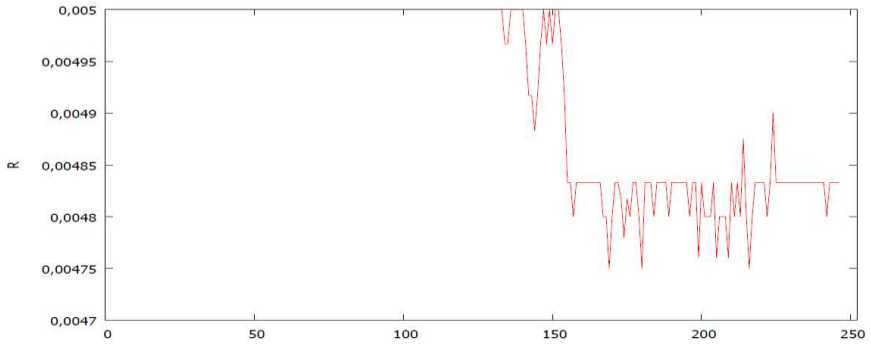
lagged differences: F(3, 237) = 27.714 [0.0000]

estimated value of (a - 1): -0.645418

test statistic: tau_c(1) = -7.02363

asymptotic p-value 2.857e-010

9.4. Unit root test for **I**



Results of the ADF test

Augmented Dickey-Fuller test for R

including one lag of (1-L)R (max was 2)

sample size 244

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + ... + e

1st-order autocorrelation coeff.for e: -0.023

estimated value of (a - 1): -0.0212887

test statistic: tau_c(1) = -1.36262

asymptotic p-value 0.6022

Results of the ADF test (first differences of selected variables)

Augmented Dickey-Fuller test for d_R

including 2 lags of (1-L)d_R (max was 2)

sample size 242

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + ... + e

1st-order autocorrelation coeff.for e: 0.005

lagged differences: F(2, 238) = 4.509 [0.0120]

estimated value of (a - 1): -1.64995

test statistic: tau_c(1) = -12.0939

asymptotic p-value 5.159e-026

ADF test results summary

Variable name inGretl	ADF testresult
u_small_vol	Variable is stationary at the 1% level of significance
u_small_dep	Variable is stationary at the 1% level of significance
I	Variable is stationary at the 1% level of significance
R	Variable is stationary in first differences at the 1% level of significance

Appendix 10

10.1) Calculation with volume of trade

Linear regression of **u_small_vol**using**I** and**R**

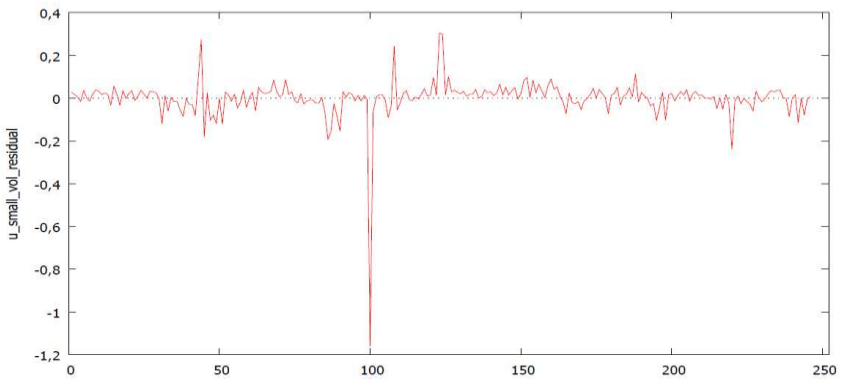
Model 2: OLS, using observations 1-246

Dependent variable: u_small_vol

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.0661555	0.34772	-0.1903	0.84927	
I	3.6602e-07	3.28275e-09	111.4980	<0.00001	***
R	11.1686	70.5456	0.1583	0.87434	

Meandependentvar	0.152540	S.D. dependentvar	0.692709
Sumsquaredresid	2.233650	S.E. ofregression	0.095875
R-squared	0.981000	Adjusted R-squared	0.980844
F(2, 243)	6273.322	P-value(F)	7.4e-210
Log-likelihood	229.2495	Akaikecriterion	-452.4990
Schwarzcriterion	-441.9831	Hannan-Quinn	-448.2647
rho	0.123051	Durbin-Watson	1.753558

ADF test results for residuals



ADF test for**u_small_vol_residual**

Dickey-Fuller test for u_small_vol_residual

sample size 245

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + e

1st-order autocorrelation coeff.for e: -0.006

estimated value of (a - 1): -0.876949

test statistic: tau_c(1) = -13.7771

p-value 1.916e-024

10.2) Calculation with amount of deposited funds

Linear regression of **u_small_dep**using**I** and**R**

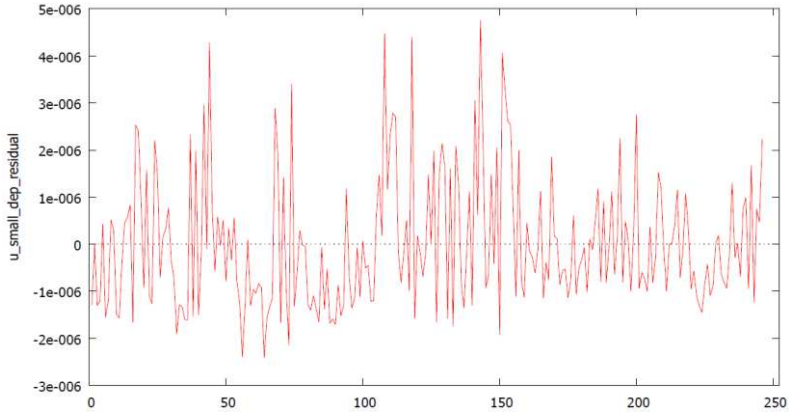
Model 1: OLS, using observations 1-246

Dependent variable: u_small_dep

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-2.48108e-05	5.06392e-06	-4.8995	<0.00001	***
I	0	0	0.0432	0.96560	
R	0.0055646	0.00102737	5.4163	<0.00001	***

Meandependentvar	2.62e-06	S.D. dependentvar	1.47e-06
Sumsquaredresid	4.74e-10	S.E. ofregression	1.40e-06
R-squared	0.108735	Adjusted R-squared	0.101399
F(2, 243)	14.82307	P-value(F)	8.43e-07
Log-likelihood	2968.954	Akaikecriterion	-5931.909
Schwarzcriterion	-5921.393	Hannan-Quinn	-5927.674
rho	0.111215	Durbin-Watson	1.765852

ADF test results for residuals



ADF test for**u_small_dep_residual**

Dickey-Fuller test for u_small_dep_residual

sample size 245

unit-root null hypothesis: a = 1

test with constant

model: (1-L)y = b0 + (a-1)*y(-1) + e

1st-order autocorrelation coeff.for e: -0.023

estimated value of (a - 1): -0.888755

test statistic: tau_c(1) = -13.8909

p-value 1.245e-024

Appendix 11.

1)

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}.$$

2)

$$\sigma = \frac{1}{n-1}\sum_{i-1}^{n}(m - x_i)^2$$

3)

$$\sigma = \frac{1}{n-1}\sum_{i-1}^{n}(m - x_i)^2 \quad x_i = \frac{P_{i+1} + P}{P_i}$$

4)

$$\sigma = \frac{1}{n-1}\sum_{i-1}^{n}(m - x_i)^2 \quad x_i = LN\left(\frac{P_{i+1}}{P_i}\right)$$