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**STRATEGIC RISK-MANAGEMENT WITH  
THE USE OF MARKET RISK INDICATOR:  
A COMPARATIVE LONGITUDINAL STUDY  
IN THE EMERGING MARKETS**

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**Abstract:** in the working paper the market risk is assessed on the base of historical data from Russian and Chinese economies during 1995-2015. The conclusion made is that the financial contagion indicator can be used for the market risk assessment for practical and theoretical purposes.

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## Introduction

In the contemporary economic circumstances the company needs the system of indicators that will help it to understand and to predict the process of the risks development: how the risks emerge, how the threats for the company arise, how much the risks menace the company etc. The crisis period data is of special value for the risks analysis.

In order to identify the crisis the special indicator that would be able to identify the degree of the threat, is needed. Such indicators have been proposed and tested many times [Longstaff, 2010; Brunnermeier & Pedersen, 2005; Allen & Gale, 2000; Kodres & Pritsker, 2002; Aragon & Strahan, 2009]. In this paper several financial contagion indicators are considered, which represent themselves significant interconnections between the companies' securities indexes return and the main financial market indicators' return.

Financial contagion is the situation on the financial market during which the interconnection of different indicators becomes stronger after the shock that has taken place in the dynamics of one of them [Longstaff, 2010].

The current research is conducted on the Russian and Chinese market data during the period of 1996-2015. Its results allow to make conclusions concerning the crisis indicators on the basis of the interconnections between the companies' shares indexes returns and the macroeconomic indicators' returns.

## Theory and Hypothesis

The history of the developing markets is full of crises. In [Kaminsky, Reinhart, Vegh, 2003] some interesting examples are considered (Table 1).

In the current study the analysis of the regularities of the financial contagion level in Russian and Chinese markets is conducted and the results are compared with historical conditions of the markets development.

The **hypothesis** is that the financial contagion indicator can be used as the market (systematic) risk indicator.

Traditionally, the credit ratings are used as the generally accepted market risk indicators. But, there are some problems with them:

- many credit ratings are based only on out-of-date information. At the same time, risk management requires risk forecasting and the preparation for the possible negative effects;

- the methodology of the credit rating evaluation is the trade secret of the rating agencies, so it is impossible to calculate them for the particular market/industry.

There are a lot of methods for calculating the credit rating of a company [Altman, Rijken, 2004; Kim, Wee, Jeon, 2006; Morales, Rodrirues, Montero, 2015; Lee, 2008; Mileris, Boguslauskas, 2011; Parmeggiani, 2013; Song, Chen, 2011].

The alternative to the credit rating approach may be the assessment of risk on the basis of the financial contagion theory. The contagion itself is defined as "an episode in which there are significant immediate effects in a number of countries following an event" [Kamimsky, Reinhart, Vegh, 2003]. The financial contagion can be defined as "an episode in which there is a significant increase in cross-market linkages after a shock occurs in one market" [Longstaff, 2010].

The development of the financial contagion theory is connected to a large extent with the works of K. Liberadzki, M. Mink, J. de Haan, N. Yunus, F. Allen, D. Gale, M. Brunnermeier, D. Pedersen and others [Liberadzki, 2015; Mink, de Haan, 2013; Yunus, 2013; Allen, Gale, 2000; Brunnermeier, Pedersen, 2005].

**Table 1. Financial crises in emerging markets, 1990-2015**

<i>Origing of the shock, country and date</i>	<i>Nature of common external chock</i>	<i>Contagion mechanisms</i>	<i>Countries affected</i>
On December, 20, 1994, Mexico announced a 15 percent devaluation of the peso. It sparked a confidence crisis, and by March 1995, the peso's value had declined by amount 100 percent	From January 1994 to December, the Federal Reserve raised the federal funds rate by amount 2.5 percentage points	Mutual funds sell off other Latin American countries, notably Argentina and Brazil.	Argentina suffered the most, losing about 20 percent of deposits in early 1995. Brazil was next, while losses in other countries in the region limited to declines in equity prices
On August 18, 1998, Russia defaults on its domestic bond debt. Between July 1998 and January 1999, the ruble depreciated by 262 percent. On September 2, 1998, it became public knowledge that LTCM <sup>1</sup> had gone bankrupt	With heavy exposure to Russia and other high-yield instruments, LTCM is revealed to be bankrupt	Margin calls and leveraged hedge funds fueled the sell-off in other emerging and high yield markets	Apart from several of the former Soviet republics, Hong Kong, Brazil and Mexico suffered most. But many emerging and developed markets were affected
On January 13, Brazil devalues the real and eventually floats on February 1. Between early January and end-February, the real depreciates by 70 percent	The crawling peg exchange rate policy (the Real Plan) that was adopted in July 1994 to stabilize inflation is abandoned	There is an increase in volatility in some of larger equity markets, and Argentina spreads widened. Equity markets in Argentina spreads widened. Equity markets in Argentina and Chile rallied. These effects lasted only a few days	Significant and protracted effect on Argentina, as Brazil is Argentina's largest trading partner
On February 22, 2001, Turkey devalues and floats lira	Facing substantial external financing needs, in late November 2000, rumors of the withdrawal of external credit lines to Turkish banks triggered a foreign exchange outflows and overnight rates soared to close to 2 000 percent	-	These has been some conjecture that the Turkish crisis may have exacerbated the withdrawal of investors from Argentina, but given the weakness in Argentina's fundamentals at the time, it is difficult to suggest developments owed to contagion
In March, 2014 some countries introduced sanctions toward	The shock was that many Russian companies had	The difficulties with the liquidity that Russian banks had	Major Russian companies received subsidies from the

<sup>1</sup> LTCM – Long-Term Capital Management – a hedge fund management firm from USA, was founded in 1994 and in 1997 its main hedge fund collapsed, following by the 1997 Asian financial crisis and 1998 Russian financial crisis

Russia (USA, European Union, Australia, New Zealand and Canada)	contracts with the foreign partners concerning technologies supply, and under sanctions, such activity became forbidden for the companies from corresponding countries. The second shock was the ruble course fall against dollar and euro	and the rise of the debts on the credit payments	state; consumer price index raised
On June 12, 2015 The Chinese stock market crash begun and about a third part of the value of the shares with the rating “A” was lost within one month	The stock market bubble led to the fact that the return rate exceeded the rate of economic growth and profits of the companies	Margin calls on the stocks on media companies	The Chinese government introduced wide measures to block the crisis; in the USA the Dow Jones Industrial index went down in August, 2015
In August, 2015 Indian stock market was influenced by The Chinese stock market crash	The crisis in China in 2015 affected Indian market	Investors from India bought Chinese companies stocks	Effect on Indian economy from the Chinese stock market crisis was severe, but not very long in time

Source: based on [Kamimsky, Reinhart, Vegh, 2003] and updated by authors

F.A. Longstaff defined **financial contagion** as an episode in which there is a significant increase in cross-market linkages after a shock occurs in one market. The standard definition in the literature of contagion is “a change in the linkages between markets following a distressed event” [Longstaff, 2010].

The contagion is characterized by several features (Table 2).

**Table 2. The view of the contagion theory by different authors**

<i>The approach for view of the contagion theory</i>	<i>Authors</i>
<i>behavioral approaches</i>	
the model of the fragility of mass behavior as a consequence of informational cascades (an information cascade occurs when it is optimal for an individual, after observing the actions of people ahead of him, to follow the behavior of the proceeding individual without regard to the individual’s own information)	S. Bikhchandani, D. Hirshleifer, I. Welch [Bikhchandani, Hirshleifer, Welch, 2003]
a model for the examination of implications of decisions that are influenced by what others are doing; the other people decisions may reflect potentially important information of their possession that is not in the public domain. The signals perceived by the first few decision makers (random and not necessarily correct) determine the market situation. This is consistent with the “excess volatility” phenomena in asset markets	A. Banerjee [Banerjee, 1992]
the suggestion that the channels of the contagion transmission arise from the global diversification of financial portfolios in the presence of information asymmetries and the model where the fixed costs of gathering and processing country-specific information give rise to herding behaviour	G. Calvo, E. Mendoza [Calvo, Mendoza, 2000]

<i>an approach on the base of trade linkages</i>	
competitive devaluations approach: since a devaluation in one country makes its goods cheaper internationally, it will pressure other countries that have lost competitiveness to devalue as well – this is described as “voluntary contagion” by C.L. Kaminsky, C.M. Reinhart and C.A. Vegh [Kaminsky, Reinhart, Vegh, 2003]; A. Lahiri, C.A. Vegh discuss an example when the central banks often go to great lengths to avoid a devaluation, often by engaging in an active interest rate defense of the existing exchange rate	R. Nurkse, S. Gerlach, F. Smets [Nurkse, 1944; Gerlach, Smets, 1996]
<i>financial approach</i>	
an arbitrage theory	A. Shleifer, R.W. Vishny [Shleifer, Vishny, 1997]
the liquidity effect	G. Calvo [Calvo, 1998]

As a result, we might state that the financial contagion gives a profound perspective to assess and to analyze market risk.

### Method

For the financial contagion estimation the Vector Autoregressive model (VAR) is generally used [Longstaff, 2010; Loukianova, Smirnova, 2015]. The VAR model used in the study has the following configuration:

$$M_t = \alpha + \sum_{k=1}^5 (\beta_k Y_{t-k} + \gamma_k B_{t-k}) + \varepsilon_t$$

where  $M_t$  - the major macroeconomic indicator index return.  $B_{t-k}$  – companies ordinary and preference shares index return;  $\varepsilon_t$  – random error;  $t$  – time moment. The number of lags in the model is 5 according to five working days in a week. This model was assessed for each pair of the company's stock price index and the macroeconomic indicator index.

The data were collected over a 25-year time frame (1990-2015). The main source of information for the Russian market was Thomson Reuters Datastream Database and for the Chinese market the data were collected from The Shanghai Stock Exchange. (Table 3). The vector autoregressive model shows the probability of the error, that’s why in this sense it is the risk measure. As far as the model itself assesses the financial contagion, the probability of the error is low then the financial contagion is strong and there exists a significant interconnection between the variables. When the model error probability is high, the financial contagion is low.

**Table 3. The scope of the research – number of companies, included in the dataset**

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Russia	-	3	4	4	10	17	15	20	25	23	36	44	65	62	60	60	60	60	60	60	60
China	1	1	2	43	44	47	53	58	61	60	60	60	60	60	60	60	60	60	60	60	60

After the model was assessed, the following table of probabilities of the regression was available for each year (Table 4).

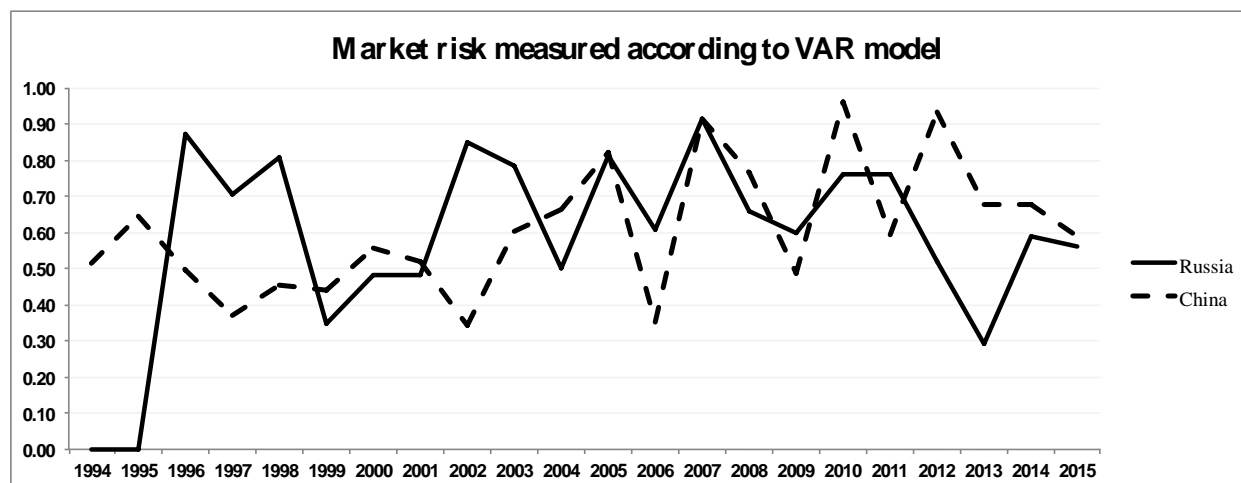
**Table 4. The p-value for the Vector Autoregression (VAR) model of 19 Russian companies for 2002.**

	RTS Index	RTS volume of trade	MICEX Index	MICEX Index of 10 leading companies	MICEX volume of trade
<i>Izhorsky plt.</i>	0.3310	0.0545	0.3742	0.2155	0.0036
<i>Samaraenergo</i>	0.2443	0.0001	0.3928	0.1374	0.0000
<i>Saratovenergo</i>	0.1644	0.0657	0.7463	0.1459	0.0021
<i>Irkutskenergo</i>	0.0935	0.0693	0.7254	0.0801	0.0022
<i>Rostelecom</i>	0.1334	0.0227	0.6031	0.1357	0.0016
<i>Sberbank of R&amp;ussia</i>	0.0712	0.0073	0.1811	0.1376	0.0008
<i>Ufa engine plant</i>	0.0712	0.0073	0.1811	0.1376	0.0008
<i>Mosenergo</i>	0.0712	0.0073	0.1811	0.1376	0.0008
<i>Avtovaz</i>	0.0712	0.0073	0.1811	0.1376	0.0008
<i>Gaz preference</i>	0.3219	0.0656	0.2744	0.2519	0.0022
<i>Kazanorgsintez</i>	0.1871	0.0966	0.4365	0.1227	0.0046
<i>Bashneft</i>	0.1145	0.0629	0.4735	0.0653	0.0037
<i>Gazprom - price index</i>	0.5111	0.0370	0.4021	0.2597	0.0019
<i>Oil company lukoil</i>	0.5528	0.0794	0.8048	0.2271	0.0044
<i>Slavneft megionneftegaz</i>	0.1134	0.0146	0.2265	0.1691	0.0014
<i>Surgutneftegas</i>	0.0989	0.0857	0.0422	0.0561	0.0007
<i>Tatneft</i>	0.1992	0.0236	0.1556	0.0458	0.0019
<i>Moscow oil refinery</i>	0.0769	0.0761	0.4762	0.1539	0.0005
<i>Gazprom neft</i>	0.1965	0.0786	0.4449	0.0542	0.0011

The results of the VAR model assessment showed the probability of the model insignificance. So it was calculated for each year.

### Results

The results are shown on the Figure. The most interesting periods from the point of view of the market risk are crises. In Appendix 1 there are the examples from the data analyzed – Russian crisis of cancelled payments (1997-1999) and Asian financial crisis (1997-1998) as well as Russian crisis of foreign trade (2014-2015).



**Figure. Market risk in Russia and China according to Vector Autoregressive model**



The results obtained in the survey are consistent with the results got by the other researchers (Longstaff, 2010; Brunnermeier & Pedersen, 2005; Allen & Gale, 2000, Kodres, Pritsker, 2002, Aragon, Strahan, 2009) for the US financial market. The results of financial contagion indicators analysis can be useful when developing a company's risk management strategy.

## **Discussion**

The market risk in Russian economy was huge in the 1990-s and the next rise of the market risk was in 2002-2003 (which cointegrates with the US crisis of telecommunication companies). In 2007 the next peak of risk can be distinguished, while in the second part of 2014 year the risk growth is seen.

China during the crisis in 2015 took strong devaluation in order to maintain competitiveness (R. Nurske mentions devaluation as the measure of the competitiveness maintenance [Nurske, 1944]). As a result of the Chinese government's measures against the 2015 financial crisis, the market risk didn't drop abruptly – in fact it declines gradually.

The financial contagion itself doesn't mean the existence of crisis, however it usually accompanies it. What is more, the significant interconnection between the financial market indicators doesn't show that the company has had losses. However, negative dynamics of the market indicators leads to uncontrollable deficits for the company because of the systematic risk realization. The risk management in essence means the risk foresight. The organization isn't able to influence on the market, but it can minimize its risks by choosing its strategy professionally, i.e. on the basis of information concerning the prognostic risk distribution. In other words, the risk is the value of the opportunities missed, and the company should use its chances to the upper limit.

The systematic risk of the company is conditional upon its inner features, however it reveals itself though the interconnection between its internal properties and the market processes. The market risk traditionally isn't evaluated because it is impossible to account for absolutely all the factors that influence a company during the assessment. The amount of the factors mentioned should be countable, because the company's field of activities is limited, and therefore the company faces the finite number of factors influencing it. However, it is rather difficult to single out the effect of certain factors, if, for example, these particular elements taken separately make indirect or insignificant influence on the company, but as their quantity is high, they make huge combined impact.

One can judge to some extent about the specific risk on the basis of the interconnection degree between the market indicators and a company's measures. This very idea underlies this research. Each company would like to use the market risk evaluation in its decision making process.

The research is devoted to the comparative analysis of different financial contagion indicators of the emerging markets. The financial contagion indicators presented in this paper for the Russian market can be adapted for the other markets and time periods.

## **Conclusion**

The results of our study show that the financial contagion indicator can be used for the market risk assessment and can such kind of analysis has both theoretical and practical implications.

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## Appendix 1

Examples from the analysed dataset: how the crisis is shown by risks

1) Asian financial crisis 1997-1998 (Markets: China and India)

in the table p-values for the vector autoregression model are presented:

1997		Company	
Stock Exchange Index		DONG FENG ELECTRONIC TECHNOLOGY	XIAMEN XIANGYU CO
	Shanghai Stock Exchange Index		0.0174
	Shenzhen Stock Exchange Index		0.0016
			0.1827
			0.0726

1998

<i>Company</i>	Shanghai Stock Exchange Index	Shenzhen Stock Exchange Index
ANHUI WANWEI UPDATED HIGH-TECH	0.5892	0.1215
BAOTOU TOMORROW TECHNOLOGY CO	0.0865	0.4511
Beijing TongRenTang Co	0.234	0.6195
China Gezhouba Group Co	0.4806	0.6809
CHINA MEHECO CO	0.4803	0.2724
CHINA RESOURCES DOUBLE – CRANE PH	0.3749	0.5273
China Resources Wandong Medical	0.4593	0.3704
China Television Media	0.6135	0.2459
CITIC GUOAN Wine CO	0.3279	0.6447
CITYCHAMP DARTONG CO	0.6446	0.6666
CSSC Steel Structure Engineerin	0.1338	0.152
DONG FENG ELECTRONIC TECHNOLOGY	0.3967	0.0805
EASTERN GOLD JADE CO	0.1338	0.4634
GINWA ENTERPRISE(GRUP)	0.3967	0.568
GREATTOWN HOLDINGS	0.1338	0.6338
GUANGDONG BOXIN INVESTING & HOL	0.3967	0.4068
HARBIN HIGH-TECH(GROUP)C	0.1338	0.621
Henan Yinge Industrial Investme	0.3967	0.2139
HISENSE ELECTRIC CO	0.6211	0.1877
Huangshan Tourism Development C	0.4499	0.7049
Humanwell Healthcare (Group) Co	0.4624	0.7352
Jiangsu Chengxing Phosph-Chemic	0.4286	0.0831
JIANGSU PROTRULY VISION TECHNOL	0.7524	0.3501
JIANGXI ZHONGJIANG REAL ESTATE	0.0986	0.5373
MINMETALS DEVELOPMENT CO	0.2221	0.3915
NANJING GAOKE CO	0.5259	0.3421
NINGBO UNITED GROUP CO	0.4711	0.291
phenix optical co	0.3712	0.7629
SDIC Essence (Holdings)Co	0.5883	0.2596
SHANGHAI MALING AQUARIUS CO	0.4472	0.2919
SICHUAN HEJIA CO	0.3826	0.0473
Sundy Land Investment Co	0.5511	0.5192
TBEA CO	0.2304	0.1639
Tianjin Hi-Tech Development Co.	0.2224	0.3619
WEIFANG BEIDA JADEBIRD HUAGUANG	0.3272	0.5681
XIAMEN XIANGYU CO	0.0653	0.0198
xin jiang hops co	0.5795	0.5623
XINJIANG TIANYE CO	0.1771	0.6
YUNNAN YUNTIANHUA CO	0.3326	0.4723
Zhejiang FuRun Co	0.339	0.7163
Zhejiang Guangsha Co	0.6606	0.5279
ZheJiang GuYueLongShan ShaoXing	0.3938	0.6998

## 2) Russian crisis of cancelled payments 1997-1999

1997						
<i>Company</i>	RTS Index	RTS volume of trade				
IZHORSKY PLT.	0.0625	0.5584				
CHERNORGORNEFT	0.0198	0.5533				
VARYEGANNEFTEGAZ	0.1463	0.5098				
MOSCOW OIL REFINERY	0.102	0.4055				

1998						
	RTS Index	RTS volume of trade	MICEX index	MICEX index of 10 large companies	MICEX index of 10 large companies	volume of trade
IZHORSKY PLT.	0.3411	0	0	0.0343		0.0683
CHERNORGORNEFT	0.7365	0.062	0.2262	0.3416		0.0001
VARYEGANNEFTEGAZ	0.5389	0.1354	0.06	0.1002		0.0779
MOSCOW OIL REFINERY	0.8203	0.0448	0.2147	0.0659		0.0031

1999						
	RTS Index	RTS volume of trade	MICEX index	MICEX index of 10 large companies	MICEX index of 10 large companies	volume of trade
IZHORSKY PLT. - PRICE INDEX	0.3912	0.0161	0.6223	0.9541		0.7355
SAMARAENERGO - PRICE INDEX	0.8323	0.6606	0.4541	0.8725		0.9748
IRKUTSKENERGO - PRICE INDEX	0.6873	0.6221	0.5043	0.8575		0.9942
ROSTELECOM - PRICE INDEX	0.2886	0.5838	0.498	0.9425		0.9616
RBANK OF RUSSIA - PRICE INDEX	0.7029	0.3642	0.4755	0.8321		0.9277
UFA ENGINE PLANT	0.6708	0.2122	0.3649	0.9456		0.9519
OIL COMPANY LUKOIL	0.6708	0.2122	0.3649	0.9456		0.9519
SLAVNEFT MEGIONNEFTEGAZ	0.6708	0.2122	0.3649	0.9456		0.9519
SURGUTNEFTEGAS	0.6708	0.2122	0.3649	0.9456		0.9519

3) Russian crisis of foreign trade 2014-2015

	2014			
	RTS Index	RTS volume of trade	MICEX Index	MICEX Index of 10 great companies
IZHORSKY PLT.				
SAMARAENERGO	1	0.7174	1	1
SARATOVENERGO	0	0	0	0
NIZHNEKAMSKSHINA	1	0.9964	0.9999	1
MAGADANENERGO	0.1975	0.0862	0.0098	0.1276
UFAORGSYNTEZ PREF.	0.1078	0.0456	0.1213	0.2255
IRKUTSKENERGO	0.9999	1	0.9961	0
ROSTELECOM	0	0	0	0
SBERBANK OF RUSSIA	1	1	1	1
UFA ENGINE PLANT	0.2363	0.1877	0.2061	0.2537
MOSENERGO	0.1503	0.1615	0.0911	0.079
AVTOVAZ	0.1839	0.4135	0.9974	0.0127
GAZ PREFERENCE	0	0	0	0
KAZANORGSINTEZ	0.9941	1	0.9988	0.9999
YARASLAVT TIREPONT	0.1798	0.2633	0.0744	0.0657
MOSCOW CITY TEL.	0.1666	0.0894	0.0712	0.1577
PHARMACY CHAIN 36.6	1	1	0.3092	0
ROSTVERTOL	0	0	0	0
URAL-SIBERIAN BANK	1	1	1	1
VACO	0.158	0.055	0.1402	0.1296
AK ILUSHINA	0.0038	0.2551	0.035	0.0933
KURG MASHSTR ZV	0.0069	1	0.9985	1
IRKUT	0	0	0	0
YAKUTSENERGO	1	1	0.9999	0.9999
BANK YAROSLAVICH	0.0001	0.2128	0.0943	0.1292
MOSCOW MUN.BK.MOSCOW	0.0982	0.1849	0.2115	0.1861
X5 RETAIL GP.GDR REG 'S'	0.759	0.9911	1	0.9998
SOLLERS	0	0	0	0
LENENERGO	1	0.9445	0.9879	1
BANK VOZROZHDENIE	0.0235	0.1166	0.1059	0.0775
TAMBOV ENERGY RETAIL	0.0982	0.033	0.1464	0.1113
OJSC ENEL OGK-5	0.759	1	0.9803	0.9288
KALUGA RETAIL	0	0	0	0
VOLGOGRADENERGOSBYT	1	1	1	1
ASTRAKHAN ENERGY RETAIL	0.0235	0.0327	0.1859	0.1406
VLADIMIR EN.DISTRIBUTING	0.0982	0.269	0.0717	0.07
UDMURT ENERGY RETAIL	0.759	1	1	1
ENERGOSBYT ROSTOVENERGO	0	0	0	0
KIROVENERGOSBYT	1	1	1	1
MORDOVIA EN.DISTRIBUTING	0.0235	0.2719	0.2199	0.073
TOMSK DISTRIBUTING	0.0982	0.2435	0.0006	0.1597
KOSTROMA RETAIL	0.759	1	0.0747	0.9982
RED OCTOBER CONF.	0	0	0	0
RAZGULAY GROUP	1	1	1	1
RYAZAN EN.DISTRIBUTING	0.0235	0.2515	0.0494	0.0447
MOSCOW INTEG.ELTY.DS.	0.0805	0.2049	0.0241	0.0622
MOSENERGOSBYT	1	1	0.8416	0.8188
ROSBANK	0	0	0	0
DAGESTAN EN.RETAIL CO.	1	0.9976	1	1
ZAVOLZHISKY MOTOR PLANT	0.1679	0.0046	0.0692	0.0981
LIPETSK EN.RETAIL CO.	0.2685	0.0097	0.1816	0.0173
VORONEZH ENERGY SALING	0.9995	0.9767	1	0.9993
PERM EN.DISTRIBUTING CO.	0	0	0	0
MAGNIT	0.9999	0.9936	1	1
TAVRICHESKY	0.1022	0.05	0.2246	0.1645
M VIDEO	0.033	0.0781	0.251	0.0033
VOLGA TGC	1	0.9053	0.9993	0.996
URALKALI	0	0	0	0
SYNERGY	1	1	1	1
LSR GROUP	0.0327	0.1981	0.2697	0.0001