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Impact of Single Stock Futures on the Volatility of Underlying Russian Stocks

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Impact of Single Stock Futures on the Volatility of Underlying Russian Stocks

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This paper looks into the effect of Single Stock Futures (SSF) introduction on the trading volume and volatility of underlying stocks in two different Russian markets. The results indicate that there is very little evidence of trading volume shift from the spot market to the futures markets. Using a GARCH(1,1) model the underlying stock volatility for 5 different stocks are estimated and these results indicate that there is a reduction in volatility after the introduction of SSF in the majority of the stocks. Granger causality tests do not indicate that the futures trading causes significant changes in stock volatility.

I. Introduction

The central question studied in this paper is the role of derivative securities in reducing stock market volatility in emerging markets. In recent years several emerging markets have introduced equity index based derivative securities and there are several studies that look into the impact of such derivatives on the volatilities of the underlying stocks[1]. One of the main drawbacks of these studies is that the underlying asset of index futures is a basket of individual stocks and hence it is difficult to interpret the results of these studies at an individual stock level. Instead of index futures this study uses the Single Stock Futures (SSF), where the underlying asset is a single stock, to study the impact of these contracts on the underlying asset volatility.

General perception about the equity derivates as expressed by Fratzscher (2006) is that "…equity derivatives have usually reduced volatility and strengthened liquidity in equity markets, enhanced returns to institutional investors such as mutual or pension funds, and reduced the cost of equity listings for firms." The counter argument against futures markets is that it can also attract speculators. Since the underlying asset market and the futures market prices are linked by arbitrage, excessive speculation in the derivative market can lead to destabilization of the underlying asset market. Most of the theoretical and empirical models use the underlying asset volatility to measure the effect of futures market. An increase in volatility of the underlying asset after the introduction of futures market can be construed as its destabilizing effect.

The theoretical explanations on the effect of introduction of derivatives on underlying asset volatility can be found in Harris (1989). He argues that derivative markets will attract well-informed speculators and will reduce the volatility due to order imbalances caused by uninformed traders. Subrahmanyam (1991) has an information based model in which both informed and uninformed investors submit orders to a competitive market maker. Market participants in this model can trade individual stocks as well as

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[1] See Kan (1997), Ryoo and Smith (2004), Zhong, Darrat and Otero (2004), Bae, Kwon and Park (2004), Pok and Poshakwale (2004), Drimbetas, Sariannidis, and Porfiris (2007), Kasman and Kasman (2008), Wang, Li, and Cheng (2009), among others.

baskets of stocks. Assuming that most of the information based trading will be on firm specific information, it will be to the advantage of uninformed traders to trade in the futures market than in the cash market. The result of this shift will be that the cash market will have a higher proportion of informed traders and lower liquidity, but this will not affect the volatility of the underlying assets. Stein (1987) uses a model with hedgers and speculators to show the destabilizing effects of futures markets. According to his model, the opening of futures markets will lead to increased speculation and this will lead to price destabilization and decreased welfare.

Introduction of a derivative contract can reduce the volatility of the underlying asset by increasing the speed at which new information is incorporated into the underlying asset price. Short-sale is one of the mechanisms by which negative information about a stock will be incorporated into the prices. Short-sales allow those investors who do not own the stock to incorporate their lower valuations into the equilibrium price of the asset (Miller, 1997). The volatility-reducing effect of SSF should also be greatest in markets where short-sales are restricted. As pointed out by Bris, Goetzmann and Zhu (2007) most of the emerging markets, including Russia, have banned or severely restricted short-sales. With the introduction of futures contracts, informed traders can use these contracts instead of short selling to incorporate negative information into pricing and thereby improving the informational efficiency of the market.

Single stock futures are traded in several exchanges, but the volume of trade of these instruments is relatively low in most of the major markets, except for emerging markets like Russia and India where these contracts have attracted considerable investor interest. The only empirical paper that studied the SSF effects on stock volatility is by Dennis and Sim (1999) using the SSF traded at the Sydney Stock Exchange. Our study is the first of its kind that looks into the impact of single stock futures on underlying stock volatility in an emerging market.

Among the emerging markets Russia is an apt candidate for this study. Since the breakup of the Soviet Union a market based economy has evolved in Russia along with publicly held joint stock companies and secondary stock markets. From its inception in the mid 1990s, Russian markets are open to foreign investors and this has contributed to the development of two separate stock exchanges – one catering predominantly to the foreign investors and the other for the domestic investors. Russian Trading System (RTS) was established in 1995 to act as a secondary market for the Russian equities, and is modeled after the NASDAQ market in the United States and the trading is done electronically. RTS primarily caters to the foreign investors and prices are quoted in U.S. dollars. Moscow Inter-bank Currency Exchange (MICEX) started trading stock in the late 1990s and has affiliated exchanges in several cities around the country. The quotes in this market are in Russian rubles and it is dominated by the domestic investors. The SSF are traded in the Futures and Options on RTS (FORTS) market, which is part of the RTS market. There are significant differences between the participants of these two exchanges. In the RTS market the minimum trading is in lots of USD5,000 which essentially restricts this market to large traders. On the other hand, MICEX has no restrictions on the minimum trading size and has a sizable number of retail investors. MICEX has over 20,000 transactions per day, while RTS has fewer than 500. Since there is sufficient distinction between the two exchanges in terms of clientele and quoted currency, this study will observe the effect of SSF introduction on the underlying stock volatility in both stock exchanges.

The rest of the paper is organized as follows. Section II describes the empirical methodology, Section III details the data, Section IV analyzes the results and Section V concludes this paper.

II. Empirical Methodology

Introduction of SSF can have an effect on the trading volume of the underlying stock by shifting some of the trading activity away from the spot market. This shift may also be an indication of high level of speculative activity in the futures market, where the cost of transaction is lower compared to the spot market. The effect of introduction of SSF on the trading volume of the underlying stock is tested using the following regression equation:

$$v_{it} = \alpha_1 + \beta_1 t + \beta_2 D + \varepsilon_t \quad (1)$$

where v_{it} is the log of trading volume in the RTS or MICEX markets, t is the time trend and D is a dummy variable with a value of 0 when there is no futures contract and 1 for those days when there is futures trading. Since most markets exhibit a growth in trading volume over time, the trend dummy t will capture this growth trend. A study by Chae (2005) shows that the distribution of daily volume is non-normal, with high skewness and kurtosis and hence, ordinary least squared method cannot be used on the level of trading volume. To alleviate this problem in this study we use a log function of the volume as suggested by Ajinkya and Jain (1989).

In this paper we measure the impact of the futures markets on the underlying asset volatility using the GARCH framework. Following Antoniou and Holmes (1995), the conditional mean and conditional volatility of each of the stocks in this study are estimated using the following GARCH(1,1) model:

$$R_{it} = a_0 + a_1 R_{Mt} + \varepsilon_t \quad (2)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma D \quad (3)$$

where R_{it} is the return of the i^{th} stock, R_{Mt} is the return of the market, h_t is the volatility and D is a dummy variable that has a value of 0 for the pre-futures period and 1 for the post-futures period. For each of the stocks in this study the sample consists of daily returns for two years prior to two years after the introductions of SSF. If the coefficient of the dummy variable is significant, then it can be assumed that the introduction of the futures contract has a significant effect on the volatility of the underlying asset.

The unconditional variance of the stock return can be calculated as $\alpha_0 /(1-\alpha_1-\beta_1)$. An increase in the unconditional variance would suggest that greater information is transmitted to the market as a result of the futures trading. To test this hypothesis the sample is divided into a 2 year time period without any futures trading and a 2 year time period with futures trading to test if there is any difference in the unconditional variance between the two periods.

This study further tests whether there is a lead-lag relationship between the futures trading and underlying asset volatility[2]. Following Pok and Poshakwale (2004), the following bivariate vector autoregressive system is employed:

[2] Lamoureux and Lastrapes (1991) suggested using volume in the variance equation of the GARCH model and their results indicated that the GARCH effect disappears when volume is introduced into the variance equation. As pointed out by Board, Sandmann and Sutcliffe (2001), introduction of volume into the variance equation can create simultaneity bias. Their argument is that volume and volatility are jointly determined by information arrivals and hence it is incorrect to assume that

$$h_t = \alpha_{1,t} + \sum_{j=1}^{k} \tau_j h_{i-j} + \sum_{j=1}^{k} \beta_j \left[\frac{V_{t-j}}{OI_{t-j}} \right] + \varepsilon_t \tag{4}$$

$$\left[\frac{V_t}{OI_t} \right] = a_{1t} + \sum_{j=1}^{n} \pi_j \left[\frac{V_{t-j}}{OI_{t-j}} \right] + \sum_{j=1}^{n} b_j h_{t-j} + \mu_t \tag{5}$$

where τ_j and π_j are coefficients of the lagged regressors of the dependent variables, V_t is the futures trading volume, and OI_t is the open interest of the futures contracts at time t. The null hypothesis is H_0: $\beta_1 = \beta_2 = \ldots\ldots = \beta_k = 0$, and if the null hypothesis is rejected, then futures trading activity causes the underlying stock market volatility.

III. Data

This study covers five SSF that are traded in the RTS market and their underlying stocks that are traded in both RTS and MICEX markets. The effects of the introduction of the SSF on the underlying stock volatility is studied by comparing the volatility of the stock two years prior to and two years after the introduction of the SSF. The two year period is chosen as to allow the effects of the introduction of the futures contracts to be fully incorporated in the underlying stock volatility. This resulted in a sample of 5 stocks[3] covering a period from 2001 to 2007. The details of these SSF are given in Table 1. The daily price and volume of the SSF and underlying stocks are obtained from RTS and MICEX.

Table 1. Details of Single Stock Futures Contracts

Name of the firm	Ticker symbol of underlying stock	Date of SSF introduction	Contract months	Contract size	Minimum initial margin
Lukoil	LKOH	9/19/2001	March, June, September, December	10 shares	12%
Rostelecom	RTKM	4/01/2002	March, June, September, December	100 shares	12%
Surgutneftegas	SNGS	9/19/2001	March, June, September, December	1,000 shares	12%
Norilsk Nickel	GMKN	9/22/2004	March, June, September, December	10 shares	12%
Sberbank	SBER	10/10/2005	March, June, September, December	100 shares	12%

volume is exogenous. To avoid this problem we are using the bivariate vector autoregressive system to test the effects of futures volume on the volatility of the underlying stock.

[3] Gazprom SSF was also introduced in 2001, but since there was not enough data on the underlying stock is available (prior to the introduction of SSF) it was not included in the study. Another SSF that is not included in this study is the SSF of United Energy Systems which was broken into several separate firms in 2008.

IV. Results

The effect of the SSF on the trading volume of the underlying stock of all five individual firms is given in Table 2. The coefficient of the time trend is negative and statistically significant for four out of five stocks listed in RTS, indicating that the trading volume in general, is decreasing in that market. On the other hand, the time-trend is positive and statistically significant for four out of the five stocks listed in the MICEX. Part of the explanation for the declining trading volume in RTS can be explained by the declining interest of foreign investors in the Russian stock market. Russian domestic investors on the contrary are much more active in the equity markets and this is reflected in the increase in MICEX trading volumes.

The coefficients of the dummy variable for the introduction of futures contract do not indicate any significant reduction in trading volume of the underlying stocks, except in the case of Rostelecom in the RTS market. Controlling for the time trend, the introduction of futures trading has resulted in a statistically significant increase in the trading volume on MICEX of Lukoil, Norilsk Nickel and Sberbank. This increase in trading volume of underlying stock may be due to the use of sophisticated hedging and arbitrage strategies used by the investors in the MICEX market. Overall the results of this

Table 2. Effect of Futures Introduction on Underlying Stock Trading Volume

Dependent Variable	α_1 (t-stat)	β_1 (t-stat)	β_2 (t-stat)	Adj. R^2 (Q-stat)
Lukoil				
RTS-volume	12.5687 (163.2132)*	-0.00118 (5.0269)*	0.27011 (1.9781)**	0.1565 (73.4482)*
MICEX-volume	11.3709 (109.2095)*	0.00235 (7.4709)*	0.37920 (2.0886)**	0.6914 (268.4784)*
Rostelecom				
RTS-volume	12.7783 (125.4439)*	0.00008 (0.2733)	-0.42812 (2.3617)**	0.1074 (106.6286)*
MICEX-volume	7.7357 (18.7463)*	0.00920 (9.4091)*	0.49543 (1.0452)	0.9684 (128.5128)*
Surgutneftegas				
RTS-volume	15.8395 (168.2310)*	-0.00112 (3.8837)* 0.00353	0.04484 (0.2690)	0.2278 (56.4983)*
MICEX-volume	14.2373 (165.0663)*	(13.5078)*	-0.11534 (0.7673)	0.7971 (156.1220)*
Norilsk Nickel				
RTS-volume	9.8954 (82.2797)*	-0.00014 (0.3920) 0.00200	0.33037 (1.5529)	0.1286 (74.2717)*
MICEX-volume	11.4199 (155.7441)*	(8.9393)*	0.41132 (3.2097)*	0.7598 (117.1735)*
Sberbank				
RTS-volume	7.7156 (61.9104)*	-0.00093 (2.4233)**	0.03571 (0.1614)	0.1511 (60.3731)*
MICEX-volume	9.6886 (111.0716)*	0.00018 (0.6880)	0.51265 (3.3708)*	0.4764 (173.8097)*

* Significant @1%; ** Significant @5%; *** Significant @10%

Table 3. Summary Statistics of Stock Returns

Panel A: RTS market

Firm	Period	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Lukoil						
Total	9/20/99-9/19/03	0.00100	0.0296	0.1799	5.8157	1417.48
Pre-futures	9/20/99-9/18/01	0.00091	0.0353	0.3134	5.0468	539.90
Post-futures	9/19/01-9/19/03	0.00109	0.0224	-0.3685	1.2943	46.21
Rostelecom						
Total	4/3/00-4/1/04	-0.00041	0.0318	-0.0854	1.9666	162.36
Pre-futures	4/3/00-3/29/02	-0.00220	0.0375	-0.0893	0.5746	7.5142
Post-futures	4/1/02-4/1/04	0.00136	0.0248	0.2212	5.0636	539.32
Surgutneftgas						
Total	9/20/99-9/19/03	0.00127	0.0345	0.0681	3.0965	401.09
Pre-futures	9/20/99-9/18/01	0.00140	0.0388	0.1049	2.2613	107.66
Post-futures	9/19/01-9/19/03	0.00108	0.0295	-0.0257	4.0692	345.03
Norilsk Nickel						
Total	9/23/02-9/22/06	0.00188	0.0269	-0.3335	4.0544	701.35
Pre-futures	9/23/02-9/21/04	0.00241	0.0264	0.0616	2.7207	154.22
Post-futures	9/22/04-9/22/06	0.00139	0.0275	-0.6835	5.1633	590.78
Sberbank						
Total	10/10/03-10/10/07	0.00267	0.0239	0.0861	3.6735	560.69
Pre-futures	10/10/03-10/7/05	0.00224	0.0213	0.1096	2.5726	137.77
Post-futures	10/10/05-10/10/07	0.00305	0.0262	0.0590	3.8127	301.93

Panel B: MICEX market

Firm	Period	Mean	Std. Dev.	Skewness	Kurtosis (Excess)	Jarque-Bera
Lukoil						
Total	9/20/99-9/19/03	0.00127	0.0288	-0.1282	2.4981	263.29
Pre-futures	9/20/99-9/18/01	0.00124	0.0334	-0.0889	2.1914	100.91
Post-futures	9/19/01-9/19/03	0.00115	0.0234	-0.2214	0.9362	22.34
Rostelecom						
Total	4/3/00-4/1/04	-0.00043	0.0330	0.0407	2.8485	338.35
Pre-futures	4/3/00-3/29/02	-0.00206	0.0384	-0.0310	1.2281	31.37
Post-futures	4/1/02-4/1/04	0.00119	0.0266	0.4466	6.4096	874.28
Surgutneftgas						
Total	9/20/99-9/19/03	0.00143	0.0354	0.0581	3.4660	502.13
Pre-futures	9/20/99-9/18/01	0.00164	0.0390	0.1343	2.3566	117.44
Post-futures	9/19/01-9/19/03	0.00116	0.0314	-0.0967	5.2289	570.40
Norilsk Nickel						
Total	9/23/02-9/22/06	0.00171	0.0267	-0.4791	3.2023	464.17
Pre-futures	9/23/02-9/21/04	0.00227	0.0268	-0.4852	3.3423	251.84
Post-futures	9/22/04-9/22/06	0.00118	0.0266	-0.4797	3.1125	219.68
Sberbank						
Total	10/10/03-10/10/07	0.00249	0.0234	0.1353	3.7463	584.89
Pre-futures	10/10/03-10/7/05	0.00213	0.0198	0.0798	2.9757	183.52
Post-futures	10/10/05-10/10/07	0.00276	0.0264	0.1373	3.3930	240.45

regression do not support the hypothesis that the introduction of futures contract shifts the trading away from the underlying stock market.

Summary statistics of stock returns before and after the introduction of the futures contracts is given in Table 3. A comparison of the standard deviations of the stock returns before and after the introduction

of the SSF will indicate whether the introduction has an effect on the volatility. In the RTS market post SSF volatilities are lower for Lukoil, Rostelecom and Surgutneftegas. For Norilsk Nickel and Sberbank the volatility is higher after the introduction of the SSF. In the case of the MICEX market only Sberbank stock has a slightly higher volatility after the introduction of the SSF. This preliminary analysis sets up the more detailed analysis of volatility using the GARCH model.

The effects of introduction of futures contracts on the underlying stock volatilities using the GARCH model are given in Table 4. In the RTS market the introduction of SSF has a statistically significant negative effect on the volatilities of Rostelecom and Norilsk Nickel. For the other three stocks the effect is statistically insignificant. Similar results are observed in the MICEX market also. These results again confirm that the introduction of SSF did not increase the volatility of the underlying stock and at least in two instances has reduced the volatility.

Given that almost all stocks, with a few exceptions, experienced a reduction in standard deviations post futures, it seems unlikely that the introduction of SSF is somehow responsible for the unique situation of Sberbank having a higher standard deviation in both the RTS and the MICEX markets, post futures. A possible reason for this particular exception could be due to the fact that Sberbank is a financial institution and that the post futures time period used in this study immediately precedes a major

Table 4. Effect of Futures Contact on Stock Volatility

Panel A: RTS market

Firm	a_0 (t-stat)	a_1 (t-stat)	α_0 (t-stat)	α_1 (t-stat)	β_1 (t-stat)	γ (t-stat)
Lukoil	-0.00085 (1.8354)***	1.0530 (57.7780)*	0.00005 (1.9370)***	0.0995 (2.6104)*	0.6383 (4.0975)*	-0.00001 (1.3667)
Rostelecom	-0.00120 (1.8213)***	1.0095 (28.4066)*	0.00005 (2.1743)**	0.0568 (2.6237)*	0.8420 (14.4090)*	-0.00002 (1.8447)***
Surgutneftgas	-0.00067 (1.5242)	1.2181 (57.1536)*	0.00003 (3.0933)*	0.1971 (4.7363)*	0.6631 (9.3287)*	-0.00000 (0.6012)
Norilsk Nickel	0.00002 (0.0430)	1.0849 (29.2270)*	0.00009 (2.1845)**	0.1045 (2.7587)*	0.6894 (5.7846)*	-0.00003 (1.7991)***
Sberbank	0.00154 (2.6492)*	0.9472 (31.7475)*	0.00007 (2.4834)*	0.1803 (2.9244)*	0.5430 (3.6115)*	0.00000 (0.2125)

Panel B: MICEX market

Firm	a_0 (t-stat)	a_1 (t-stat)	α_0 (t-stat)	α_1 (t-stat)	β_1 (t-stat)	γ (t-stat)
Lukoil	-0.00055 (1.0858)	0.9346 (33.0414)*	0.00009 (3.4374)*	0.1889 (4.8135)*	0.6338 (8.4442)*	-0.00005 (2.9298)*
Rostelecom	-0.00028 (0.4012)	0.9527 (24.8352)*	0.00012 (2.0838)*	0.1481 (3.1365)*	0.7043 (6.7566)*	-0.00004 (1.5087)
Surgutneftgas	-0.00032 (0.4766)	0.9193 (25.7735)*	0.00021 (2.3770)*	0.3299 (4.6986)*	0.4912 (3.5645)*	-0.00011 (2.1845)**
Norilsk Nickel	0.00009 (0.2008)	1.0262 (40.0259)*	0.00007 (3.1287)*	0.1345 (3.8444)*	0.6083 (6.0272)*	-0.00002 (1.5658)
Sberbank	0.00181 (4.0993)*	0.8728 (33.5856)*	0.00002 (2.2911)**	0.1370 (3.4403)*	0.7482 (9.5850)*	0.00000 (0.7519)

* Significant @1%; ** Significant @5%; *** Significant @10%

financial crisis. Therefore higher levels of volatility for Sberbank could have been a systematic response to the uncertainty in the global financial services sector at that time rather than a result of the introduction of SSF.

The GARCH(1,1) parameters for the total, pre-futures and post-futures periods are given in Table 5. Unconditional variance for the total sample and the sub-periods can be estimated as $\alpha_0/(1-\alpha_1-\beta_1)$. A change in unconditional variance after the introduction of the SSF will show its effect on the volatility of the underlying stock. In the RTS market the unconditional variance after the introduction of the SSF is lower than that of the pre-futures unconditional variance for all stocks except Sberbank. Similar results

Table 5. GARCH(1,1) Model Parameters at the Total, Pre-Futures and Post-Futures Period

Panel A: RTS market

Firm	a_0 (t-stat)	a_1 (t-stat)	α_0 (t-stat)	α_1 (t-stat)	β_1 (t-stat)	$\alpha_0/(1-\alpha_1-\beta_1)$	$(\alpha_1+\beta_1)$
Lukoil							
Total	-0.00073 (1.7591)***	1.0513 (58.9521)*	0.00001 (1.6843)***	0.0653 (2.3247)**	0.8531 (11.8997)*	0.000173	0.918490
Pre-futures	-0.00017 (0.3123)	1.0471 (46.8510)*	0.00004 (2.2875)**	0.2396 (2.5910)*	0.6134 (4.7869)*	0.000251	0.853190
Post-futures	-0.00106 (2.0454)**	1.0398 (35.6664)*	0.00012 (1.0878)	0.0552 (1.1265)	0.0556 (0.0664)***	0.000134	0.110844
Rostelecom							
Total	-0.00127 (1.8265)***	1.0068 (30.5784)*	0.00003 (2.4243)**	0.0726 (3.1792)*	0.8707 (22.2102)*	0.000472	0.943391
Pre-futures	-0.00333 (3.0421)*	1.1458 (25.0587)*	0.00020 (1.9239)***	0.1084 (1.9733)**	0.5261 (2.5410)**	0.000558	0.634599
Post-futures	0.00014 (0.1753)	0.8611 (17.4990)*	0.00004 (2.8055)**	0.0705 (2.5379)**	0.8232 (16.2098)*	0.000346	0.893715
Surgutneftgas							
Total	-0.00066 (1.4578)	1.2175 (56.3723)*	0.00004 (3.1876)*	0.1957 (4.4235)*	0.6681 (8.8695)*	0.000272	0.863892
Pre-futures	0.00006 (0.0918)	1.2153 (45.7765)*	0.00002 (1.9645)**	0.1453 (3.3532)*	0.7692 (10.0631)*	0.000278	0.914558
Post-futures	-0.00130 (2.1181)**	1.2418 (32.8186)*	0.00006 (2.5960)*	0.2927 (3.1011)*	0.4804 (3.0771)*	0.000267	0.773214
Norilsk Nickel							
Total	0.00006 (0.0990)	1.0619 (29.7676)*	0.00003 (1.5290)	0.0670 (2.1269)**	0.8591 (11.1884)*	0.000352	0.926206
Pre-futures	0.00126 (1.4168)	0.8786 (15.8665)*	0.00006 (1.4245)	0.0804 (1.9659)**	0.7763 (5.9008)*	0.000418	0.856721
Post-futures	-0.00047 (0.6644)	1.2129 (28.2602)*	0.00011 (3.3544)*	0.1666 (2.6613)*	0.4088 (2.6679)*	0.000269	0.575509
Sberbank							
Total	0.00153 (2.7939)*	0.9481 (31.2008)*	0.00008 (2.5824)*	0.1822 (3.0229)*	0.5395 (3.6124)*	0.000273	0.721726
Pre-futures	0.00140 (1.9338)***	0.8242 (21.7995)*	0.00039 (8.4401)*	-0.0336 (1.6375)	-0.6526 (3.7725)*	0.000232	-0.686268
Post-futures	0.00069 (1.0213)	1.1255 (21.9835)*	0.00008 (2.3736)**	0.2911 (2.5089)**	0.4568 (2.4723)**	0.000307	0.748038

Table 5. GARCH(1,1) Model Parameters at the Total, Pre-Futures and Post-Futures Period (Cont.)

Panel B: MICEX market

Firm	a_0 (t-stat)	a_1 (t-stat)	α_0 (t-stat)	α_1 (t-stat)	β_1 (t-stat)	$\alpha_0/(1-\alpha_1-\beta_1)$	$(\alpha_1+\beta_1)$
Lukoil							
Total	-0.00001	0.9226	0.00001	0.0626	0.9285	0.000404	0.991044
	(1.1538)	(34.8250)*	(1.5014)	(3.4717)*	(42.8337)*		
Pre-futures	-0.00036	0.8843	0.00010	0.1893	0.6075	0.000522	0.796830
	(0.4254)	(24.6831)*	(2.3923)**	(2.8041)*	(4.6902)*		
Post-futures	-0.00079	0.9894	0.00004	0.1907	0.6729	0.000272	0.863688
	(1.2031)	(25.0781)*	(2.2528)**	(3.7200)*	(7.1801)*		
Rostelecom							
Total	-0.00019	0.9449	0.00007	0.1571	0.7530	0.000747	0.910240
	(0.2730)	(25.0493)*	(3.5684)*	(3.9038)*	(13.5398)*		
Pre-futures	-0.00179	0.9961	0.00008	0.1748	0.7415	0.000989	0.916426
	(1.5246)	(19.7048)*	(1.9683)**	(2.9031)*	(9.4568)*		
Post-futures	-0.00013	0.9129	0.00033	0.2856	0.0580	0.000497	0.343584
	(0.1634)	(16.4231)*	(6.0881)*	(3.3838)*	(2.3258)**		
Surgutneftgas							
Total	-0.00043	0.9178	0.00005	0.2375	0.7115	0.001089	0.949076
	(0.7147)	(26.2543)*	(2.4789)**	(5.3638)*	(11.9289)*		
Pre-futures	0.00029	0.8522	0.00012	0.1817	0.6939	0.000942	0.875696
	(0.2554)	(6.7949)*	(0.8422)	(1.8966)***	(2.9401)*		
Post-futures	-0.00057	1.0077	0.00024	0.5563	0.0886	0.000683	0.644921
	(0.6911)	(19.1412)*	(4.4885)*	(5.5241)*	(0.7825)		
Norilsk Nickel							
Total	0.00011	1.0253	0.00006	0.1443	0.6284	0.000278	0.772792
	(0.2264)	(51.4883)*	(2.9833)*	(3.8852)*	(6.1875)*		
Pre-futures	0.00069	1.0363	0.00017	0.2398	0.2046	0.000315	0.444483
	(0.7770)	(26.5503)*	(2.8515)*	(3.3442)*	(0.9283)		
Post-futures	-0.00042	1.0180	0.00004	0.0942	0.7136	0.000233	0.807910
	(0.6421)	(31.7596)*	(2.6771)*	(2.8016)*	(7.8282)*		
Sberbank							
Total	0.00180	0.8757	0.00003	0.1362	0.7509	0.000241	0.887217
	(4.2002)*	(35.6392)*	(2.2838)**	(3.3393)*	(9.3061)*		
Pre-futures	0.00198	0.7082	0.00003	0.0909	0.7629	0.000196	0.853925
	(3.2410)*	(20.9411)*	(1.7148)***	(2.3418)**	(7.2371)*		
Post-futures	0.00129	1.0449	0.00001	0.0952	0.8523	0.000254	0.947611
	(2.0889)**	(28.4749)*	(1.3695)	(2.2745)**	(11.5761)*		

* Significant @1%; ** Significant @5%; *** Significant @10%

are also observed for the MICEX market, which is again an indication that the introduction of the SSF has reduced the volatility of the underlying stock. To further emphasize that the introduction of SSF did not increase volatility, it should be noted that all stocks (with only one exception where the estimated coefficient is perfectly zero) had coefficients with negative signs. In other words, whether the effect was statistically significant or not, the direction towards a reduction in volatility was nearly uniform across all stocks.

As stated in Engle and Bollerslev (1986), if the total of the GARCH parameters $(\alpha_1+\beta_1)$ is greater than 0.9, it is an indication that the persistence of the shocks to the volatility is permanent. In the case RTS market the sum of GARCH parameters are greater than 0.9 for the total sample for Lukoil, Rostelecom, and Norilsk Nickel indicating the persistence of shocks. For Surgutneftegas only the pre-

futures values are greater than 0.9. In the case of MICEX market the sum of GARCH parameters are greater than 0.9 for the total sample of Lukoil, Rostelecom and Surgutneftegas. In the case of Rostelecom the pre-futures values are greater than 0.9, while the same is true for the post-futures parameters for Sberbank.

Table 6. Futures Trading Activity vs. Conditional Volatility of Individual Stocks – VAR Results

Panel A: Dependent Variable – Volatility; Independent Variable – Volume/Open Positions

Independent Variable	LKOH Coeff. (t-stats)	RTKM Coeff. (t-stats)	SNGS Coeff. (t-stats)	GMKN Coeff. (t-stats)	SBER Coeff. (t-stats)
h_{t-1}	0.85944	0.23823	0.63466	0.89100	0.94271
	(20.1656) *	(5.1444) *	(13.7329) *	(19.4615) *	(18.6986) *
h_{t-2}	-0.06693	0.02171	-0.17447	-0.03413	-0.01680
	(1.1707)	(0.4569)	(3.2078) *	(0.5556)	(0.2447)
h_{t-3}	-0.02971	0.02410	0.03557	-0.02539	0.17468
	(0.5202)	(0.5125)	(0.6437)	(0.4111)	(2.5487) **
h_{t-4}	0.07464	0.04446	-0.05978	0.05131	-0.08512
	(1.3117)	(0.9481)	(1.0819)	(0.8313)	(1.2358)
h_{t-5}	-0.09935	0.02019	0.15102	-0.08478	-0.11865
	(1.7506) ***	(0.4312)	(2.7571) *	(1.3807)	(1.7161) ***
h_{t-6}	0.05098	0.03724	0.03971	0.00252	-0.04923
	(0.8991)	(0.7967)	(0.7214	(0.0411)	(0.7069)
h_{t-7}	0.14949	0.05208	-0.03547	0.01426	0.11032
	(2.6443) *	(1.1171)	(0.6439)	(0.2327)	(1.6084)
h_{t-8}	-0.14873	0.00760	0.13861	0.04081	-0.06148
	(2.6539) *	(0.1628)	(2.5356 **	(0.6652)	(0.8929)
h_{t-9}	0.00494	0.00542	-0.07170	-0.03168	0.03470
	(0.6917)	(0.1190)	(1.5295)	(0.6917)	(0.6951)
r_{t-1}	-0.00010	-0.00015	-0.00009	0.00008	0.00012
	(0.1191)	(0.5851)	(0.1952)	(0.7113)	(1.4924)
r_{t-2}	-0.00010	-0.00004	0.00019	0.00009	-0.00004
	(0.5860)	(0.1535)	(0.3752)	(0.7942)	(0.4208)
r_{t-3}	0.00020	-0.00011	0.00008	-0.00012	-0.00032
	(1.1564)	(0.4002)	(0.1564	(1.0287)	(3.8736) *
r_{t-4}	0.00001	-0.00025	-0.00054	0.00006	0.00008
	(0.0300)	(0.9544)	(1.0839)	(0.4931)	(0.9897)
r_{t-5}	0.00002	0.00049	0.00032	-0.00006	0.00011
	(0.1454)	(1.8684) ***	(0.6413)	(0.5419)	(1.3077)
r_{t-6}	0.00007	-0.00036	-0.00028	0.00011	0.00006
	(0.4369)	(1.4005)	(0.5664)	(0.9967)	(0.6602)
r_{t-7}	0.00001	0.00010	-0.00011	0.00001	-0.00006
	(0.0747)	(0.3826)	(0.2200)	(0.1107)	(0.6873)
r_{t-8}	-0.00010	0.00023	0.00029	0.00000	0.00008
	(0.5703)	(0.9149)	(0.5819)	(0.0109)	(0.9050)
r_{t-9}	-0.00010	-0.00026	0.00010	0.00009	-0.00002
	(0.6444)	(1.0820)	(0.2065)	(0.8342)	(0.3327)
Constant	0.00307	0.01084	0.00774	0.00313	0.00104
	(5.5812) *	(5.0719) *	(3.6444) *	(4.8481) *	(2.9573) *
$\frac{V_t}{OI_t}$ does not Granger cause h_t (F-stats)	0.3762	0.8957	0.2254	0.5628	2.4827*

* Significant @1%; ** Significant @5%; *** Significant @10%

Table 6. Futures Trading Activity vs. Conditional Volatility of Individual Stocks – VAR Results (Cont.)

Panel B: Dependent Variable – Volume/Open Positions; Independent Variable – Volatility

Independent Variable	LKOH Coeff. (t-stats)	RTKM Coeff. (t-stats)	SNGS Coeff. (t-stats)	GMKN Coeff. (t-stats)	SBER Coeff. (t-stats)
h_{t-1}	-1.01324	7.02043	11.98586*	52.23891	67.91927
	(0.0815)	(0.8303)	(2.6141)	(2.6408) *	(2.0838) **
h_{t-2}	8.81814	17.98874	-14.58635	-60.72604	-53.16158
	(0.5289)	(2.0736) **	(2.7030) *	(2.2875) **	(1.1974)
h_{t-3}	-12.14872	-3.98832	-2.99955	-2.48755	12.27345
	(0.7294)	(0.4646)	(0.5470)	(0.0932)	(0.2770)
h_{t-4}	-0.46092	-12.49567	-2.57669	-15.06708	11.36909
	(0.0278)	(1.4594)	(0.4700)	(0.5650)	(0.2553)
h_{t-5}	-0.31401	-1.29880	3.07667	15.22853	-96.91299
	(0.0190)	(0.1519)	(0.5661)	(0.5740)	(2.1681) **
h_{t-6}	4.13696	4.17709	-5.02708	-2.97366	46.98809
	(0.2502)	(0.4895)	(0.9204)	(0.1122)	(1.0435)
h_{t-7}	9.71163	-2.05143	1.48051	34.99755	-35.10779
	(0.5890)	(0.2410)	(0.2709)	(1.3213)	(0.7917)
h_{t-8}	-8.28474	-9.56470	3.36785	1.21962	47.20460
	(0.5069)	(1.1224)	(0.6210)	(0.0460)	(1.0604)
h_{t-9}	-8.46986	-3.42121	3.03351	-24.97998	-14.46990
	(0.7009)	(0.4117)	(0.6522)	(1.2624)	(0.4484)
r_{t-1}	0.41460	0.34242	0.36808	0.33160	0.44544
	(8.8067) *	(7.3883) *	(7.9829) *	(7.2069) *	(8.8992) *
r_{t-2}	0.15988	0.11239	0.10651	0.07154	0.06938
	(3.1535) *	(2.2988) **	(2.1669) **	(1.4747)	(1.2840)
r_{t-3}	0.08021	0.02019	-0.03468	0.09403	0.00857
	(1.5581)	(0.4133)	(0.7025)	(1.9337) ***	(0.1586)
r_{t-4}	0.09826	0.10241	0.10329	0.10622	0.13272
	(1.9214) ***	(2.1361) **	(2.0939) **	(2.1747) **	(2.4253) **
r_{t-5}	-0.09975	0.08869	0.04711	-0.01301	0.03946
	(1.9928) **	(1.8536) ***	(0.9493)	(0.2655)	(0.7195)
r_{t-6}	0.02973	0.08016	0.03433	-0.04405	-0.02706
	(0.5958)	(1.7070) ***	(0.6949)	(0.9035)	(0.4985)
r_{t-7}	-0.02939	-0.05712	0.04955	0.00320	-0.00166
	(0.5929)	(1.2097)	(1.0035)	(0.0657)	(0.0307)
r_{t-8}	0.05674	0.06996	-0.02047	-0.02018	0.09292
	(1.1521)	(1.4989)	(0.4181)	(0.4189)	(1.7332) ***
r_{t-9}	-0.05105	0.06004	0.08298	0.08333	0.09293
	(1.1205)	(1.3510)	(1.8148) ***	(1.8258) **	(1.9271) ***
Constant	-0.27100	-0.36590	-0.52107	-0.73174	-0.10199
	(1.6906) ***	(0.9373)	(2.4721) **	(2.6260) *	(0.4489)
h_t does not Granger cause $\frac{V_t}{OI_t}$ (F-stats)	0.3921	1.1223	1.8982***	1.5781	1.6317

* Significant @1%; ** Significant @5%; *** Significant @10%

The exception for Sberbank being a stock that did not experience a reduction in unconditional variance after the introduction of SSF is consistent with the general rising uncertainty among financial services firms during the time period that preceded the global financial crisis.

The results of the lead-lag relationship between the futures trading activity and the volatility of the underlying stock are given in Table 6. Since there is strong similarity in the results of RTS and MICEX markets, for brevity, only the results of the MICEX market is reported. Only in the case of Rostelecom and Sberbank do the lagged values of the futures trading activity have significant effects on the volatility of the underlying stock. The lagged values of the volatility itself had significant effect on the volatility of all five stocks studied. The effects of volatility on trading activity are more interesting. Except for Lukoil, all other four futures trading volumes are significantly affected by the lagged values of volatility. This is an indication that during times of high volatility investors may be using the futures markets for hedging purposes and this might be the reason for high futures trading activity. In all five cases the lagged variables of the futures trading volume had significant effects on futures trading activity. This is an indication of periods of persistent high trading activity in the futures markets.

Granger causality tests on whether futures market trading activity causes the changes in underlying stock volatility are generally insignificant, except in the case of Sberbank. In the case of Surgutneftegas there is weak evidence that volatility causes increase in futures trading activity. Overall conclusions that can be drawn from these results are that there is very limited causal effect between the underlying stock volatility and the trading activity in the futures markets.

V. Conclusion

The central question that was examined in this paper is the role of derivatives in reducing the volatility of emerging stock markets. Specifically, the introduction of SSF in the Russian markets is looked at with respect to the possible results on Russian stock behavior. The particular issues that were looked at included whether the use of SSF corresponded to a change in stock market trading volume, whether stock-return standard deviations increased or decreased after the introduction, and whether the changes in volatility are significant when using GARCH methodology.

In general, given the five stocks analyzed, the results found that the introduction of SSF has a somewhat positive-to-mixed effect on the volume of trading, and that persistent periods of high volatility seem to lead to more SSF use. Most importantly, it was found that the overall long-term volatility of stock returns has generally decreased for the stocks in this sample since the introduction of these instruments.

When a comparison of basic descriptive statistics is made before and after the introduction of SSF, it was found that in most cases, but not all, the standard deviations of individual stock returns decreased after introduction among the five stocks used in this paper in both the RTS and MICEX markets.

When the issue of volatility was examined using the GARCH methodology, it was found that the introduction of SSF resulted in statistically significant reductions in volatility in two out of five stocks on both markets. In the other stocks the coefficient signs were almost always consistent with a decline in volatility but the effects were not statistically significant.

Furthermore, when the estimations are done on a total, pre-futures and post-futures basis, the unconditional variance decreased post-futures for every stock except one on both markets, and that frequently, the persistence of the reduction seemed to be permanent.

Potential areas for further study would include the theoretical question of what is the transmission mechanism of reduced volatility, is it a result of restrictions on short-selling or other reasons, and under what cases would there be exceptions? Additional areas could also include: Does the tendency of SSF in reducing volatility hold in other emerging markets besides Russia, and if not, what is the explanation?

References

Ajinkya, B. B., and Jain, P. C. (1989). The behavior of daily stock market trading volume. *Journal of Accounting and Economics*, 11, 331–359.

Antoniou, A., and Holmes, P. (1995). Futures trading and spot price volatility: evidence for the FTSE-100 stock index futures contract using GARCH. *Journal of Banking and Finance*, 19, 117–129.

Bae, S. C., Kwon, T.H., and Park, J.W. (2004). Futures trading, spot market volatility, and market efficiency: The case of the Korean index futures markets. *Journal of Futures Markets*, 24, 1195-1228.

Board, J., Sandmann, G., and Sutcliffe, C. (2002). The effect of futures market volume on spot market volatility. *Journal of Business Finance and Accounting*, 28, 799-819.

Bris A., Goetzmann W. N., and Zhu, N. (2007). Efficiency and the bear: Short sales and markets around the world. *Journal of Finance*, 62, 1029-1079.

Chae, J. (2005). Trading volume, information asymmetry, and timing information. *Journal of Finance*, 60, 413-442.

Dennis, S. A., and Sim, A. B. (1999). Share price volatility with the introduction of individual shares futures on the Sydney futures exchange. *International Review of Financial Analysis*, 8, 153–163.

Drimbetas, E., Sariannidis, N., and Porfiris, N. (2007). The effect of derivatives trading on volatility of the underlying asset: evidence from the Greek stock market. *Applied Financial Economics,* 17, 139–148.

Engle, R. F., and Bollerslev, T. (1986). Modeling the persistence of conditional variances. *Econometric Reviews*, 5, 1-50.

Fratzscher, O. (2006). Emerging derivative markets in Asia. *EAP flagship on Asian financial market development* (Washington: World Bank).

Harris, L. (1989). S & P 500 cash stock price volatilities. *Journal of Finance*, 44, 1155–1175.

Kan, C. V. (1997). The effect of index futures trading on volatility of HSI constituent stocks: A note. *Pacific-Basin Finance Journal*, 5, 105–14.

Kasman, A., and Kasman, S. (2008). The impact of futures trading on volatility of the underlying asset in the Turkish stock market. *Physica A: Statistical Mechanics and its Applications*, 387, 2837-2845.

Lamoureux, C.G., and Lastrapes, W.D. (1990). Heteroskedasticity in stock return data: Volume versus GARCH effects. *Journal of Finance*, 45, 221-229.

Miller, E. M.. (1977). Risk, uncertainty, and divergence of opinion, *Journal of Finance*, 32, 1151-1168.

Pok, W. C. and Poshakwale, S. (2004). The impact of the introduction of futures contracts on the spot market volatility: the case of Kuala Lumpur stock exchange. *Applied Financial Economics*, 14, 143–154.

Ryoo, H. J., and Smith, G. (2004). The impact of stock index futures on the Korean stock market, *Applied Financial Economics*, 14, 243–51.

Stein J. C. (1987). Informational externalities and welfare-reducing speculation. *The Journal of Political Economy*, 95, 1123-1145.

Subrahmanyam, A. (1991). A theory of trading in stock index futures. *Review of Financial Studies*, 4, 17-51.

Wang, S. S., Li, W., and Cheng, L.T.W. (2009). The impact of H-share derivatives on the underlying equity market. *Review of Quantitative Finance and Accounting*, 32, 235-267.

Zhong M., Darrat, A. F. and Otero, R. (2004). Price discovery and volatility spillovers in index futures markets: Some evidence from Mexico. *Journal of Banking and Finance*, 28, 3037-3054.