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FUNDAMENTAL FACTORS AFFECTING THE MOEX RUSSIA INDEX: STRUCTURAL BREAK DETECTION IN A LONG-TERM TIME SERIES

This paper studies how the influence of the fundamental factors on the Russian stock market changes retrospectively. We empirically test the impact of daily values of fundamental factors (indexes of foreign stock markets, oil price, exchange rate and interest rates in Russia and the USA) on the MOEX Russia Index over long time interval from 2003 to 2018. The analysis of the ARIMA-GARCH (1,1) model with a rolling window reveals the changes in the power and direction of the influence of the fundamental factors which are probably caused by the structural instability revealed earlier in Russia and other stock markets. The Quandt-Andrews breakpoint test and Bai-Perron test identify the number and likely location of the structural breaks. We find multiple breaks probably associated with dramatic falls in the stock market index, for example with the significant falls of the then MICEX index in the spring of 2006 and the global financial crisis of 2008-2009. The results of the regression models over the different regimes, defined by the structural breaks, can vary markedly over time.

JEL Classification: C22, G14, G15.

Keywords: Russian stock market, the MOEX Russian index, fundamental factors, structural breaks, long-term time series, rolling regression, breakpoint tests.

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Introduction

The fundamental analysis is based on macroeconomic indicators and business activity indices and is widely used to study the Russian stock market (see, for example, Hayo and Kutan, 2005; Jalolov and Miyakoshi, 2005; Anatolyev, 2008; Samoilov, 2010; Peresetsky, 2011; Asaturov and Teplova, 2012; Cheremushkin, 2014). These factors include macroeconomic and industry factors, the basic principles and the financial statements of the company (Hmyz, 2007). Understanding how fundamental factors affect the Russian stock market has great significance in macroeconomic forecasting, in particular in early warning systems for financial crises (Bussiere and Fratzsher, 2006; Solntsev et al. 2011), and investment strategy. Recent studies, however, indicate that the influence of fundamental factors changes over time. It is reflected in the high variability of estimated coefficients (Anatolyev, 2008; Peresetsky, 2011) and in the presence of structural breaks (Cheremushkin, 2014), identified also for other economic and financial variables. For each fundamental factor, structural breaks can occur at different times (Rapach and Wohar, 2006; Cheremushkin, 2014). Structural instability was also found for stock markets in the US (Rapach and Wohar, 2006), China (Li, Wang, 2015) and some emerging countries which are geographically close to Russia—Poland, Hungary, the Czech Republic, Turkey—and also South Africa (Korhonen and Peresetsky, 2016).

Structural breaks can occur for a number of reasons: changes in stock market regimes (Cheremushkin, 2014), market sentiments, speculative bubbles, changes in monetary and debt management policies (Pesaran and Timmerman, 2002). Failure to take into account structural breaks in financial data results in many undesirable consequences. For example, the use of static statistical models leads to underestimating the true relationship between variables and complicates predictions (Cheremushkin, 2014). Therefore, before using fundamental factors for modeling and forecasting the indicators of the Russian stock market, it is important to detect structural breaks and to analyze their probable causes.

The main contribution of this paper is the retrospective analysis of fundamental factors and the detection of structural breaks in the stock market in Russia over a long period. These structural breaks are typically characteristic of longer time series in particular because of the fact that fundamental factors are long-term in nature. Using a long time series provides more opportunities to analyze which events are associated with the presence of these breaks. The present study examines the impact of daily values of fundamental factors on the MOEX Russia Index from 2003 to 2018. As a basic variable describing the global character of the Russian stock market, the MOEX Russia Index contains information about the most liquid stocks of the largest Russian companies.

The detection of structural breaks lets researchers improve the modeling and prediction of the influence of fundamental factors on the Russian stock market and this should be done over a long period. Therefore, in this paper we use a long time series, identify the structural breaks, and explain their possible economic reasons. Our approach is based on applying a rolling window regression and statistical procedures for the identification of structural breaks.

The article is organized as follows. We first provide an overview of the fundamental factors of stock markets and present recent developments in the field of structural instability. Then we estimate Autoregressive Integrated Moving Average Model (ARIMA) and Generalized Autoregressive Conditional Heteroscedasticity Model (ARIMA-GARCH) for understanding the relationship between variables on average over the interval. Next we analyze how the influence of fundamental factors has changed over the years, by applying a regression analysis with a rolling window. Then we use statistical tests to detect the change points and explain the structural breaks together with large contemporaneous economic events. Based on statistical procedures, breaks are identified, 3 sub-gaps are identified, on which there is a unidirectional influence of factors. Understanding the probable causes of the changing nature of the relationships between variables can be used to predict the influence of fundamental factors on the stock market index in the future.

Theoretical background

Fundamental factors of Russian stock market

There is a substantial literature on the study of different fundamental factors to explain the dynamics of the Russian stock market. These factors reflect the degree of integration of the Russian stock market with international financial markets, the state of the economy, and the stock market participants.

The international integration of the Russian stock market is reflected in the dependence on the stock market indices and the credit indicators of the foreign markets. For example, the positive and significant influence of the US stock market on average over the interval was revealed by analyzing the daily (Hayo and Kutan, 2005; Cheremushkin, 2014; Peresetsky, 2011) and weekly returns on stocks and indices of the Russian stock market (Anatolyev, 2008). The influence of the NIKKEI 225 index on the MICEX index was significantly positive on daily data from 2001 to 2010 (Peresetsky, 2011). Daily data from 1995 to 2011 showed that the Russian stock market is, to the greater extent, influenced by the volatility of the German and Japanese stock markets, and, to a lesser extent, by the volatility of the Hong Kong, Korean and British stock markets (Asaturov and Teplova, 2012) The negative impact of 3-month US Treasury bills rate on the Russian stock market was identified in earlier studies (Anatolyev, 2008).

The state of the main economic sectors is reflected in, for example, the indicators of the credit and money markets and macroeconomic indicators. The influence of the 1-month Moscow interbank offer rate on the MSCI index on average is negative on weekly data from 1995 to 2005, while the indicators of the Russian money market are statistically insignificant on weekly data from 2000 to 2004 (Anatolyev, 2008). The GDP index is the least significant of the other macroeconomic factors on monthly data from January 2007 to September 2008 according to an analysis of the MICEX index by using the Exponential Generalized Autoregressive Conditional Heteroscedastic model (EGARCH) (Fedorova and Pankratov, 2010). The influence of the exchange rate was statistically insignificant for weekly data from 1995 to 2004 on average over the interval (Anatolyev, 2008).

Most of the Russian stock market value is in export-oriented energy companies. Therefore, indicators of their financial statements depend on the dynamics of external factors, in particular, the price of oil. The positive statistically significant effect of oil prices was revealed on daily data from 2001 to 2006 (Peresetsky, 2011), although there was no significant effect of oil prices on the profitability of Russian stocks (Jalolov and Miyakoshi, 2005) on monthly data from 1995 to 2003. In addition, it was found that the market reacted negatively to dividend announcements on average over the period from 2010 to 2012 (Berezinets et al., 2015). The performance of the Russian stock market is also influenced by other factors, for example, public opinion (De Vries et al., 2012) and news events (Goryaev and Sonin, 2005; Hayo and Kutan, 2005). This, however, is a separate direction of research.

From the above, we can conclude that in recent years, the dynamics of the Russian stock market are mainly defined by international integration, the US and Japan stock market indices, the interest rates of the US and Russian credit markets, the exchange rate, and oil prices, which influence the financial statements of fuel and energy sector stock market participants. In this paper we apply these fundamental factors to explain the dynamics of the Russian stock market.

Detecting the structural instability of the Russian stock market

The majority of studies have concentrated on investigating the influence of fundamental factors on average over a defined time period, while some researchers, mentioned above, (Anatolyev, 2008; Cheremushkin, 2014; Peresetsky, 2011) found that inside these time periods the influence of fundamental factors changed significantly. For example, a rolling regression analysis on weekly data indicates that the regression coefficients for the US MSCI index halved throughout the period 2000-2003 and the explanatory power of the regression varies from a few percent in 2003 to nearly 50% in 2004 (Anatolyev, 2008). In the literature there are conflicting results on the influence of fundamental factors for different time intervals, for example, in studying the influence of oil prices (Jalolov and Miyakoshi, 2005; Peresetsky, 2011) and stock markets indexes of other countries (Asaturov and Teplova, 2012; Samoylov , 2010).

A possible reason for such structural instability is the presence of structural breaks which was tested for in stock markets of the various countries, for instance, the UK and Japan (Andreou, 2002), the USA (Andreou, 2002; Micosch, 2003; Rapach and Wohar, 2006; Smith, 2008), Hong Kong (Andreou, 2002), China (Li,Wang, 2015). Structural breaks can occur for a number of reasons (changes in stock market regimes (Cheremushkin, 2014), market sentiments, speculative bubbles, changes in monetary and debt management policies (Pesaran and Timmerman, 2002)). Some early attempts to test for structural breaks in the Russian stock market are found in (Cheremushkin, 2014) in analyzing the degree of dependence of the Russian stock market indexes MICEX and RTS on the dynamics of the S&P 500 index and Brent crude oil price on daily data for the period 1997-2014. It was found that the regression coefficients can vary markedly over the different intervals identified by structural breaks. The presence of the structural breaks in the volatility of returns for “Gazprom” ordinary shares on the daily data for the period of 2006-2016 has been also proven by the using a new method based on the moving likelihood ratio statistics in the piecewise-specified GARCH-models (Borzykh, 2017).

Building on these pioneering studies, we conduct an updated retrospective analysis on the Russian stock market over a longer time-interval with the aggregation of a large number of fundamental factors and analyze the structural instability in terms of time and factors. The paper contributes to the literature by formally testing for structural breaks using multivariate and bivariate regression models of the MOEX Russia Index based on fundamental factors appearing in the literature. The description of the data and the methodology are presented in the following two sections.

Data

This paper uses daily data of the MOEX Russia Index (IMOEX) and fundamental factors for the period 2003:01–2018:04. Data from the daily closing prices of S&P500 (S&P500) and NIKKEI 225 (NIKKEI), Brent crude oil price (BRENT) and ruble/USD official exchange rates (USDCB) are published on the official website of Finam[4]. The 3-month US Treasury bills rate (TBILL) and 1-month Moscow interbank offer rate (MIBOR) are from the official website of the Central Bank of the Russian Federation[5] and US Department of the Treasury[6], respectively. Data on the Moscow interbank offer rate is available until 2016:12[7].

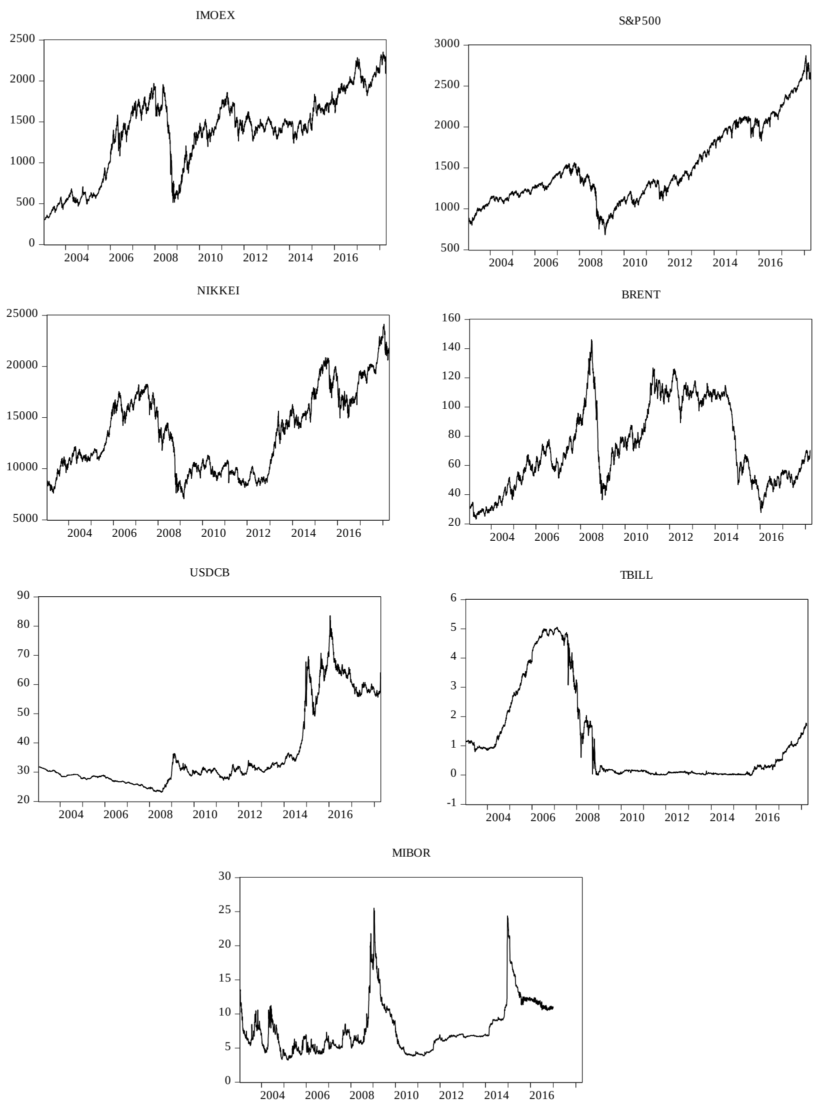

Fig. 1. Time-series plots, daily data, 2003:01-2018:04

[4] Official site of "Finam". Available at: http://www.finam.ru/ (accessed 31.07.2019).
[5] Official site of Central Bank of Russian Federation. Available at: http://www.cbr.ru/ (accessed 31.07.2019).
[6] US Treasury Department official site. Available at: http://www.treasury.gov/ (accessed 31.07.2019).
[7] Starting from 1 January 2017 the calculation and publication of the mentioned rate was terminated.

Fig. 1 shows that from 2003 to 2018 the IMOEX increased more than 7-fold from 302.65 to 2353.16, S&P500 and NIKKEI indices also show a positive trend over this period. BRENT was significantly volatile from $23.2 to $146.09 per barrel. On average the price was $72.52 per barrel. USDCB increased by 3.5 times, reached its maximum on January 22, 2016 and in 2 years fell to 62 rubles per dollar. MIBOR was also quite volatile (1-month): it reached a maximum of 25% on January 23, 2009, and dropped to 3.9% by October 2010. The sharp drop in rates was repeated after the events of December 2014. The 3-month rate US Treasury bills rate dropped from 5% to 0% from January 15, 2007 to November 19, 2008 and remained at this level until 2015. By April 2018, it reached 1.7%. Some similarities in the behavior of the indices and the price of oil can be noted during the global crisis: the decrease in the indices and oil prices observed in 2008 was caused by the collapse of the global stock market in August-October of that year.

Because the time series described above are non-stationary, we transform them. We use log-return, $\Delta\ln(p_t) = \ln(p_t/p_{t-1})$, of stock market indexes, BRENT and USDCB and first differences ($\Delta y_t = y_t - y_{t-1}$) of interest rates in Russia and the USA which are stationary based on the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests. Tab. 1 below gives the descriptive statistics of the data. Log-return of IMOEX and BRENT were most volatile among the log-return of variables during our sample period. Russian interest rates are more volatile than interest rates in the USA.

Tab. 1. Descriptive statistics

	Mean	Median	Max	Min	Std. Dev.
Δln(IMOEX)	0.000516	0.000884	0.020129	-0.206571	0.252261
Δln(NIKKEI)	0.000241	0.000372	0.014270	-0.121110	0.094941
Δln(S&P500)	0.000288	0.000556	0.011282	-0.094695	0.097743
Δln(BRENT)	0.000214	0.000501	0.018324	-0.099065	0.152417
Δln(USDCB)	0.000176	-0.000010	0.007610	-0.128638	0.102993
ΔMIBOR	-0.000655	0.000000	0.278815	-2.360000	3.460000
ΔTBILL	0.000147	0.000000	0.046688	-0.810000	0.940000

Methodology

To study the influence of the fundamental factors we estimate ARIMA and ARIMA-GARCH models with fundamental factors of the Russian stock market. GARCH models are used for modeling time series data when the data exhibits heteroscedasticity and volatility clustering and are popular in the econometrics literature for modeling the indicators of the Russian stock market (Jalolov and Miyakoshi, 2005; Hayo and Kutan, 2005; Peresetsky, 2011; Lozinskaia and Zhemchuzhnikov, 2017). We select the lag order p and the order of moving average q for the ARIMA (p,d,q) model based on minimization of the Akaike information criteria and the Schwartz information criteria. Due to the insignificance of the regression coefficients in different specifications of the ARIMA model and the difficulty in interpreting a large number of lags we use the lag order p=1 applied in the earlier studies of the Russian stock market (Peresetsky, 2011).

Since the trading session in New York opens later than trading in Moscow, only the previous day's S&P returns can be used in regressions explaining stock market returns in Moscow (Peresetsky, 2011; Korhonen and Peresetsky, 2016). American markets continue to operate, while Russian domestic markets are already closed, hence we include lagged 3-month US Treasury bills rate in equations (Anatolyev, 2008). USDCB and BRENT are lagged in the estimated equations too. NIKKEI is taken without a lag of 1 day, since the trading session in Japan is closed before the Moscow trading session opens (Peresetsky, 2011; Korhonen and Peresetsky, 2016). MIBOR is also taken without a lag of 1 day (Anatolyev, 2008).

Thus, the ARIMA equation with fundamental factors to be estimated is:

$$\Delta\ln(\mathrm{IMOEX}_t) = \beta_0 + \beta_1 * \Delta\ln(\mathrm{IMOEX}_{t-1}) + \beta_2 * \Delta\ln(\mathrm{SANDP}_{t-1}) + \beta_3 * \Delta\ln(\mathrm{BRENT}_{t-1}) + \\ + \beta_4 * \Delta\ln(\mathrm{NIKKEI}_t) + \beta_5 * \Delta\ln(\mathrm{USDCB}_{t-1}) + \beta_6 * \Delta\mathrm{MIBOR}_t + \beta_7 * \Delta\mathrm{TBILL}_{t-1} + \varepsilon_{t.} \quad (1)$$

where β_1 ... β_7 are unknown regression coefficients and ε_t is an error term, t = 2, ..., 3479.

Then the ARIMA-GARCH (1,1) model with fundamental factors is estimated to check the stability of the regression results. The GARCH model (1,1) is widely used in econometric papers for analysis of the Russian stock market (Hayo and Kutan, 2005; Peresetsky, 2011). Hence, ε_t, an error term, could follow process: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \gamma\sigma_{t-1}^2$.

We use rolling regressions with the ARIMA-GARCH (1,1) model with fundamental factor specification in order to estimate the time-varying coefficients β_i in equation (1). The window length is 240 days, which is approximately equal to the number of trading days per year excluding weekends and holidays. Equation (1) is estimated for the interval (t-240, t) for each t (t> 241) and regression coefficients $\beta i\ (t)$, i = 1, ..., 8, t = 241, ..., 3,478 and standard errors are calculated.

In the presence of structural instability the most important issue is to detect the break points. When the break point is known, testing for structural breaks is standard and, for instance, can be based on the Chow test. In this paper the Quandt-Andrews and Bay-Perron tests are used to search for unknown structural changes in the models by analogy with the existing econometric studies of the Russian (Cheremushkin, 2014) and American (Rapach and Wohar, 2006) stock markets. More specifically, we use the Quandt-Andrews test (Andrews, 1993; Andrews and Ploberger, 1994; Quandt, 1960) to test for a structural break at an unknown date for a given regression equation. The algorithm is the application of the Chow test for each observation τ between surrounding dates or observations, τ_1 and τ_2.The most likely break point is an observation for which the F-statistic F(τ) is maximum. The maximum value of the all calculated individual Chow F-statistics is:

$$MaxF = \max_{\tau_1 \leq \tau \leq \tau_2}(F(\tau)) \qquad (2)$$

While the Quandt-Andrews test is primarily designed to test for a single structural break, multiple breaks may exist. We also use the Bai-Perron test (Bai and Perron, 1998, 2003) to test for multiple structural breaks at unknown dates. We consider a standard model of multiple linear regression with T periods and potential structural breaks m that divide the sample into m + 1 different regimes. The null hypothesis of no breaks is tested against the alternative hypothesis of an unknown number of breaks with an upper-bound, m*, using two statistics UDmax and WDmax (Bai and Perron, 1998). In addition to the multivariate model (ARIMA model with fundamental factors), we test for structural breaks in six bivariate regression models of IMOEX to identify breaks for each of the six fundamental factors listed in the previous section. After that we analyze the possible dates of change points and interpret the results.

Empirical results

Estimates of ARIMA and ARIMA-GARCH (1,1) models

Estimates of the regression models for the IMOEX log-return are presented in Tab. 2. The signs of the regression coefficients are resistant to changes of the model specification. All variables in the ARIMA-GARCH (1,1) model, with the exception of the log-return of exchange rate and the first differences of the US interest rate are statistically significant at the 1% level; Russian short-term interest rates are statistically significant at the 10% level. Similar signs of the regression coefficients for the log-return of MICEX, S&P 500, NIKKEI and BRENT were noted in (Peresetsky, 2011) on daily log-return data of the MICEX index from 2000 to 2010. It indicates that, on average, over a given interval, these fundamental factors retain their influence.

Tab. 2. Estimates of equation (1) in period 2003:1 – 2016:12

	ARIMA	ARIMA-GARCH (1,1)
$\Delta\ln(IMOEX)_{t-1}$	-0.0954^{***}	-0.0722^{***}
	(0.0354)	(0.0213)
$\Delta\ln(NIKKEI)_t$	0.3847^{***}	0.1960^{***}
	(0.0652)	(0.0240)
$\Delta\ln(S\&P500)_{t-1}$	0.1179	0.1060^{***}
	(0.0762)	(0.0349)
$\Delta\ln(BRENT)_{t-1}$	0.1024^{***}	0.0621^{***}
	(0.0244)	(0.0135)
$\Delta\ln(USDCB)_{t-1}$	0.0215	0.0077
	(0.0396)	(0.0347)
$\Delta MIBOR_t$	-0.0055^{***}	-0.0025^{*}
	(0.0018)	(0.0015)
$\Delta TBILL_{t-1}$	-0.0157	0.0025
	(0.0177)	(0.0076)
Constant	0.0005	0.0010
	(0.0003)	(0.0003)
Variance		
$\widehat{\varepsilon^2_{t-1}}$	-	0.1143^{***}
		(0.0213)
$\widehat{\sigma^2_{t-1}}$	-	0.8660^{***}
		(0.0255)
Adjusted R^2	0.10	0.08
Observations	3478	3478

Notes: Notes: *,**, *** indicate significance at the 10%, 5%, and 1% levels, respectively; robust standard errors are given in parentheses.

Estimates of models in rolling windows

We run rolling regression for the ARIMA-GARCH (1,1) model with fundamental factors to analyze how the influence of fundamental factors on the Russian stock market has changed over the years. The evolution of regression coefficients with 95% confidence intervals is presented in Fig. 2.

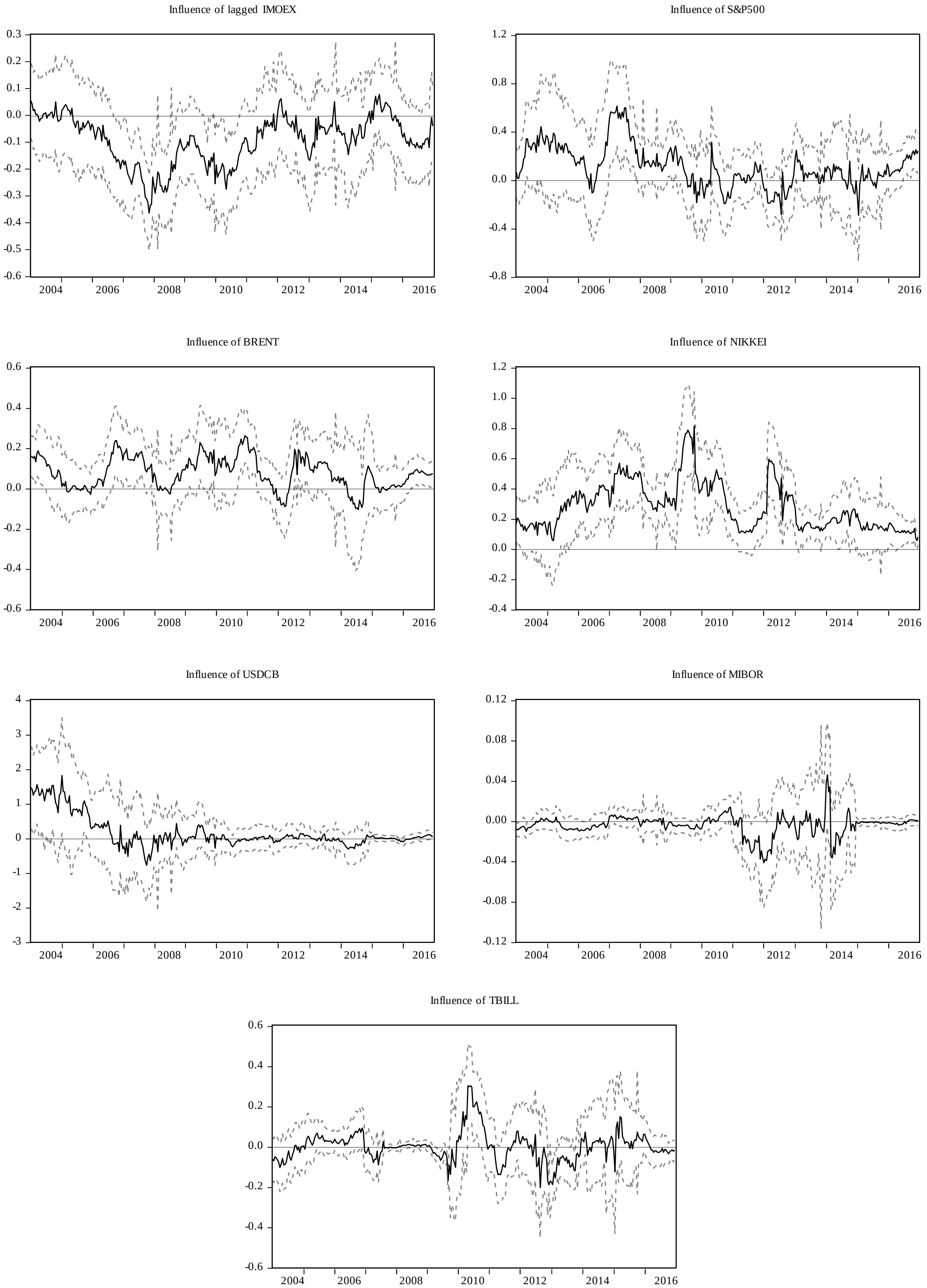

Fig. 2. Evolution of coefficients for ARIMA-GARCH (1,1) model with fundamental factors

The influence of NIKKEI was significantly positive in June-October, 2009: the regression coefficient was from 0.67 to 0.81, more than three times that the average value, 0.19, in this period. In more recent years the degree of its influence decreased however, the influence was the statistically significant: the Japanese market is the nearest to the Russian stock market in terms of closing time, and it absorbs the latest news from the global financial market that appeared after the closing of the trading session in the US on the previous trading day (Peresetsky, 2011).

The influence of the interest rates in the US and Russia was the most unstable: during the period their influence constantly switched from positive to negative which greatly complicates the economic interpretation of these factors.

The evolution of the regression R^2 is depicted in Fig. 3. The explanatory power of the regression varied considerably, from almost zero, observed May 15, 2005 and in February–December 2015 to nearly 25% in June–September 2009. Similar findings were noted in (Anatolyev, 2008; Korhonen and Peresetsky, 2016; Peresetsky, 2011). In (Peresetsky, 2011) the sharp increase in explanation power during the crisis of 2008–2009 was explained by the high values of market returns and volatility for the period.

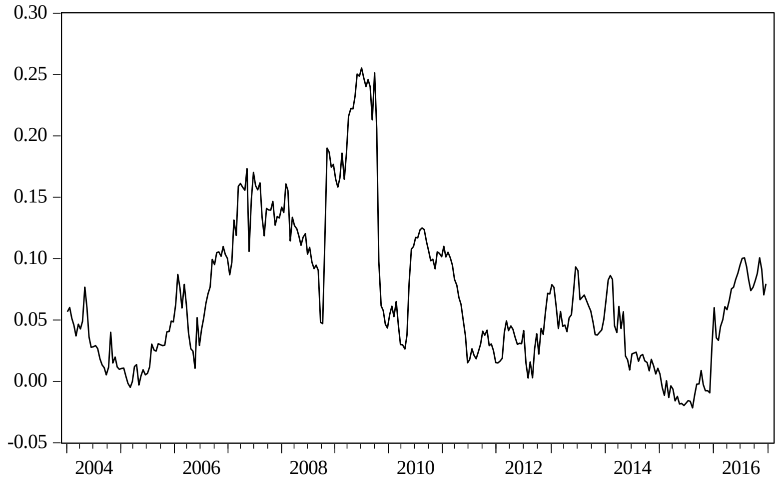

Fig. 3. Evolution of the regression R^2

The results indicate that the influence of all fundamental factors on IMOEX was not constant: the power and direction of the influence changed during the period. Maximum values of regression coefficients for NIKKEI, S&P500, BRENT and lagged IMOEX were several times greater than the average during the period. The greatest impact of NIKKEI on IMOEX was during the 2009 crisis; BRENT, in 2006 and 2009–2010, S&P500 and lagged IMOEX in 2007 which includes the pre-crisis, crisis and post-crisis periods.

Detection of structural breaks in the multivariate model

The result of the Quandt-Andrews test for the ARIMA model with fundamental factors is presented in Fig. 4. The maximum value of F-statistics (16.46) was statistically significant at the 1% level and was reached on November 28, 2008. It is the most likely point of a structural break.

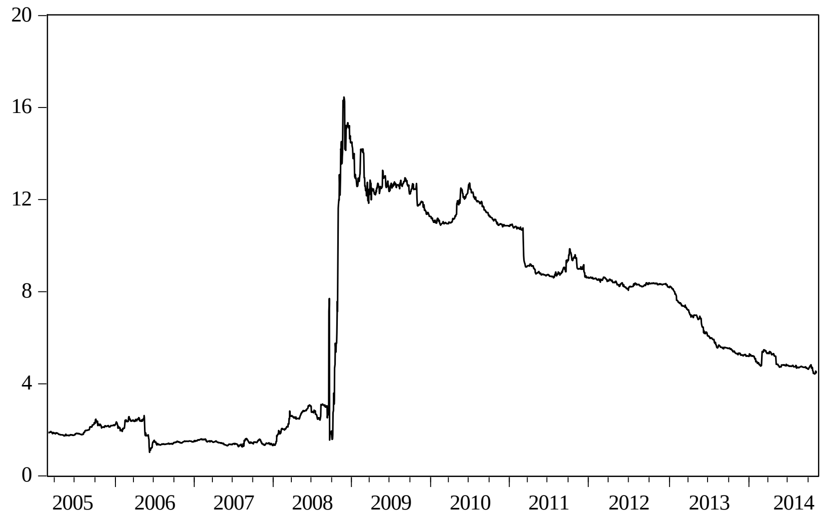

Fig. 4. F-statistics for the Quandt-Andrews test for the ARIMA model with fundamental factors

Tab. 3 reports the results of the Bai-Perron test for identifying multiple breaks. The calculated statistics are statistically significant at the 1% level. UDmax statistics indicate the presence of two breaks in the model – April 25, 2006 and November 28, 2008. WDmax statistics also indicates the presence of a break on January 13, 2011.

Tab. 3. Bai-Perron test for the ARIMA model with fundamental factors

UDmax	WDmax (1%)	WDmax (5%)	WDmax (10%)
34.26***	43.77***	40.81**	39.44*

Notes: *,**, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

The results of the statistical tests indicates the most likely points of structural breaks, however, we should explain the breaks together with nearby big economic events. The first break date, likely corresponds to the events in May 2006. On May 22, 2006, the MICEX index fell by 9.65% and reached the lowest level since January 19, 2006 – 1143.76 points. Trading was suspended on the Russian stock exchange for the first time after the market collapse on October 27, 2003, related to the Yukos affair. The second break data in November 2008 corresponds to the global financial crisis of this year. The crisis in the subprime mortgage market in the US led to a liquidity crisis of world banks, a crisis in the real sector of the economy and a production decline in many countries. For three months the capitalization of Russian companies fell by 75%

and a drop in oil prices resulted in an economic slowdown. Thus the results indicate that the structural breaks are probably defined by the dramatic falls of the stock market index, which had a significant impact on the economy.

The results of the regression models over the different regimes, defined by the structural breaks, presented in Tab. 4, varied markedly over time. The maximum value of R^2, 28%, was reached in the second period, including the pre-crisis and crisis periods. Similar values of R^2 were noted in the rolling regression model. In the first and third periods, the R^2 did not exceed 5%. In all models, NIKKEI and BRENT had a positive effect at the 1% level. For these factors, the slope coefficients were almost three times smaller as we move from the second regime to the third regime, so that the predictive power of these factors was substantially reduced over the last eight years of the full sample.

Tab. 4. ARIMA with fundamental factors regression model estimation results in different regimes, defined by the structural breaks

	(1) 23.01.2003-24.04.2006	(2) 25.04.2006-27.11.2008	(3) 28.11.2008-30.12.2016
$\Delta \ln(IMOEX)_{t-1}$	0.0051 (0.0336)	-0.1619** (0.0722)	-0.1039*** (0.0315)
$\Delta \ln(NIKKEI)_t$	0.2433*** (0.0609)	0.7878*** (0.1446)	0.2405*** (0.0355)
$\Delta \ln(S\&P500)_{t-1}$	0.2117*** (0.0798)	0.2251 (0.1445)	0.0115 (0.0593)
$\Delta \ln(BRENT)_{t-1}$	0.0933*** (0.0303)	0.2625*** (0.0947)	0.0819*** (0.0247)
$\Delta \ln(USDCB)_{t-1}$	0.4502 (0.4315)	-0.3861 (0.5532)	0.0201 (0.0343)
$\Delta MIBOR$	-0.0052** (0.0026)	-0.0088 (0.0074)	-0.0035* (0.0343)
$\Delta TBILL_{t-1}$	0.0005 (0.0257)	-0.0310 (0.0200)	0.0117 (0.0300)
Constant	0.0016** (0.0007)	-0.0005 (0,0009)	0.0006* (0.0003)
Adjusted R^2	0.04	0.28	0.05
Observations	806	645	2027

Note: *,**, *** indicate significance at the 10%, 5%, and 1% levels, respectively; robust standard errors are given in parentheses.

Detection of structural breaks in bivariate models

Structural breaks for different fundamental factors can occur at different dates. Tab. 5 presents the results for statistically significant bivariate regression models with the fundamental factors of the Russian stock market – NIKKEI, S&P 500, BRENT and MIBOR. We find evidence of single structural break in three of the six bivariate regression models in the second half of 2008 year, during the global financial crisis that was revealed for the multivariate regression model (Tab. 6). There is evidence of multiple structural breaks in bivariate predictive regression models of IMOEX based on NIKKEI. In addition to the breaks identified for the multivariate regression model, the most likely change points are also April 7, 2011 and March 17, 2014. The results indicate that structural breaks for multivariate and bivariate regression models can differ.

Tab. 5. Bivariate regression models estimation results

	(1)	(2)	(3)	(4)
$\Delta\ln(S\&P500)_{t-1}$	0.3133^{***} (0.0665)	-	-	-
$\Delta\ln(NIKKEI)_t$	-	0.3998^{***} (0.0602)	-	-
$\Delta\ln(BRENT)_{t-1}$	-	-	0.1345^{***} (0.0270)	-
$\Delta MIBOR_t$	-	-	-	-0.0051^{***} (0.0020)
Constant	0.0004 (0.0003)	0.0004 (0.0003)	0.0005 (0.0003)	0.0006 (0.0003)
Adjusted R^2	0.03	0.08	0.02	0.01
Observations	3799	3800	3799	3479

Note: *,**, *** indicate significance at the 10%, 5%, and 1% levels, respectively; robust standard errors are given in parentheses.

Tab. 6. Quandt-Andrews test and Bai-Perron test for bivariate regression models

	QA test		BP test	
	MaxF	Breakpoint	WDmax (1%)	Breakpoint
$\Delta\ln(S\&P500)_{t-1}$	22.01^{***}	25.11.2008	11.84	-
$\Delta\ln(NIKKEI)_t$	43.14^{***}	02.12.2008	20.50^{***}	26.05.2006 02.12.2008 07.04.2011 17.03.2014
$\Delta\ln(BRENT)_{t-1}$	5.75^{*}	25.08.2008	9.77	-
$\Delta MIBOR_t$	2.99	27.02.2007	9.53	-

Note: *,**, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

The presence of structural breaks was tested earlier on daily data from 1997 to 2014 (Cheremushkin, 2014). There was evidence of three structural breaks in the bivariate regression model of IMOEX based on the S&P500 index (June 21, 2003; June 5, 2007 and April 12, 2011), and four structural breaks in bivariate regression model of IMOEX based on Brent oil

(December 19, 2001; January 18, 2006; July 18, 2008 and July 21, 2011). This could indicate that the results may depend on the statistical procedure, the time period, the transformations for the data, and the data frequency is used in the work. Nevertheless, the presence of structural breaks for these fundamental factors is confirmed: we find evidence of single and multiple structural breaks for multivariate and bivariate regression models.

Conclusion

In this paper, building on the pioneering literature about the changing nature of the dependence of fundamental factors on Russian stock market, we study the effect of daily values of fundamental factors on the MOEX Russia Index over a longer time interval (2003:01–2018:04). This study updated the results of earlier papers. The results indicate that the influence of fundamental factors on MOEX Russia Index is not constant: the power and direction of the influence changed during the period for both multivariate and bivariate regression models. The regression coefficients for the different regimes, defined by the structural breaks, can vary markedly over time. For this reason failure to take into account the structural breaks in financial data results in underestimating the true relationship between variables. However, the results indicate that structural breaks for multivariate and bivariate regression models can differ.

The structural breaks in the multivariate regression model of MOEX Russia Index (April 25, 2006 and November 28, 2008) are probably associated with dramatic falls of the stock market index. This could have been caused by a sharp change in the dynamics of the fundamental factors or other factors and events that were not taken into account in the regression models but affected the behavior of investors. Understanding the probable causes of the changing nature of relationships between variables can be used to predict the influence of fundamental factors on the stock market index in the future.

The use of other methods to detect structural breaks, for example, using the Markov-switching time series model (Cheremushkin, 2011; Kuan, 2013), is a direction for future research.

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