What determines the behavior of the Russian stock market

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Abstract
In this paper we empirically test the dependence of the Russian stock market on the world stock market, world oil prices and Russian political and economic news during the period 2001-2010. We find that oil prices are not significant after 2006, the Japan stock index is significant over the whole period, since it is the nearest market index in terms of closing time to the Russian stock index. We find that political news like Yukos arrests or news on the Georgian war have a short term impact, since there are many other shocks, the structural instability of the Russian financial market is confirmed.

Key words: Russian stock market, oil, gas, financial market behavior, financial market integration, stock market returns, news, emerging markets, transition economies
JEL: G10, G14, G15, C5.

1. Introduction

In the mass-media and amongst Russian financial analysts one can often find statements like "The Russian stock market is determined by the US stock market", "The Russian stock market is determined by oil (gas) prices". Also statements that internal Russian political shocks (like the Yukos affair, Putin's statement on Mechel, etc.) have a significant long-term impact on the Russian stock market. In this paper we test these assertions empirically using data from financial markets.

There are a lot of papers studying market returns, but only a few of them study Russian stock market returns, integration of the Russian stock market into the international financial market, or the influence of political shocks on Russian stock market returns.

The first papers to make an econometric analysis of the emerging Russian financial and stock market were published in 2000. Rockinger and Urga (2000) investigated the weak-form efficiency for markets in transition economies (including Russia), and find some evidence for the tendency to markets' efficiency. Peresetsky and Ivanter (2000) studied integration of the Russian financial markets into the international financial market. They analyzed daily market data for the period 1996:05–1997:10 and came to conclusion of increasing integration of Russian and international financial markets during that period, which weakened approaching to the August 1998 crisis. Also they suggested that there is global movement of the international financial market and when one considers correlations between daily market returns between Russian, US, Japan, European financial markets it is necessary to take the time lag between different markets' closing times into account. Peresetsky, Turmuhambetova, Urga (2001) analyzed the risk premium of the Russian government bond markets using daily market data for the period 1996:09–1998:03.

Jalolov and Miyakoshi (2005) employed an EGARCH model using monthly data for the period 1995:05–2003:03. They found that the German market rather than the US market is a better predictor for Russian stock market monthly returns due to the closer German relations in trade and investment with Russia. They did not find a significant influence of oil and gas prices on Russian stock returns. They found that one-step prediction with the EGARCH model is not useful since it is worse than the random walk model prediction in terms of the root mean squared error.

Hayo and Kutan (2005) studied Russian stock market daily returns using an asymmetric GARCH model with Student distribution of errors. They found that lagged values of Russian stock index return, S&P return, oil index return are significant in prediction of the Russian stock index return[1]. Thus the hypothesis of an efficient market was rejected. Also they analyzed the direct influence of news on returns and volatility of the Russian stock index. Since the Russian economy depends heavily on oil and gas, they take energy news as economic news and news on the Chechen war as political news. They have constructed three dummies for good, bad and neutral energy news and three corresponding dummies for the Chechen war news. They have found that all news fails to be significant both for explanation of returns and for volatility of returns. Only S&P shocks are found to be significant in the TGARCH variance equation. Negative S&P shocks increase volatility of the Russian stock index; positive S&P shocks decrease volatility of the Russian stock index. When the square of the lagged S&P return is included into the variance equation, it demonstrates a significant positive effect, which indicates a "direct" volatility link between the two markets.

Anatolyev (2005) analyzed weekly stock market returns for the two periods: first 1995:01–2005:01, and second, after the 1998 crisis period 1999:10–2005:01. He finds that during the last years of the second period the influence of oil prices decreased and the influence of US indices increased. He finds significant variation in explanatory power of the models over subperiods. He finds that integration of the Russian stock market with European market is higher than with US or Asian markets. Also he pointed out that structural instability of the Russian financial market is not restricted to financial crises. The weak-form market efficiency of the Russian stock market was confirmed.

Goryaev and Sonin (2005) applied a methodology similar to that in (Hayo and Kutan, 2005) to study the influence of positive and negative news on the Yukos affair on the Yukos stock price relative to the market. They found that the two dummy variables are significant for the Yukos stock returns during the analyzed period of 2002:01–2003:10. Also they study the influence of Yukos news on other companies' stock returns.

[1] They find that only 1-day lagged returns are significant, which is in line with a study (Eun, Shim, 1998) of relations between stock index returns of industrial countries.

Chesney, Reshetar, and Karaman (2011) suggest a non-parametric approach to event study. They empirically analyze the impact of terrorism on the behavior of daily stock market returns.

Our paper contributes to the literature in three directions. First, we analyze Russian stock index daily returns for the period of 2000:01–2010:10, which includes the relatively stable period of 2000–2007; second we allow model coefficients to evolve over that period estimating models in rolling windows, hence we can conclude on trends of dependence of Russian stock market of external shocks; third, we consider moving dummies to find out all possible internal shocks to measure their relative size in comparison with shock related to the political events (e.g. Yukos affair).

2. Data and models

We use daily market indices and oil prices for the period of 2000:01–2010:10 from Bloomberg and Datastream. We take MICEX index to represent the Russian stock index. The MICEX Stock Exchange is Russia's leading stock exchange. Its proportion on the Russian on-exchange share market is over 80%. The MICEX Stock Exchange is the largest stock exchange in the CIS, Eastern and Central Europe. It is the center of the formation of liquidity for Russian securities and the main market for international investments in shares and bonds of Russian companies.

Various US, European and Asian stock indices and various oil prices were tested for the GARCH(1,1) model over the whole period. It happens that S&P500, NIKKEI 225 stock averages, and WTI[2] have better explanatory power than other indices that we tested. Since the trading session in New York opens later than the trading session in Moscow, only previous day S&P can be used in regression. Trading sessions in Europe open 2 or 3 hours later than in Moscow, so also only lagged European index returns could be used in regression. Since the lagged US index is closer in time to the Russian index than the European index is, it is not surprising that the US index outperforms the European index in the explanation of the Russian stock index, since it absorbs more information. The trading session in Japan is already closed before the Moscow trading session opens. Hence the same day NIKKEI return can be used in regression and it includes additional information on the world financial market which arose after closing of the previous day's US trading session.

So the main equation that we estimate is

$$R\_MICEX_t = \beta_0 + \beta_1 R\_MICEX_{t-1} + \beta_2 R\_SNP_{t-1} + \beta_3 R\_WTI_{t-1} + \beta_4 R\_NIKKEI_t + \varepsilon_t, \quad (1)$$

[2] Crude Oil-WTI Spot Cushing (CRUDOIL, Datastream).

where the prefix $R\_$ denotes log-return, $R\_INDEX_t = \ln(INDEX_t / INDEX_{t-1})$, $MICEX$, SNP, $NIKKEI$, and WTI denote MICEX, S&P500, NIKKEI 225 stock indices and WTI oil price. We consider several specifications of equation (1); ε_t error term could be homoscedastic or follow one of GARCH(1,1) type processes:

(m0) $\sigma_t^2 = \sigma_0^2$;

(m1) $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2$;

(m2) $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2 + \delta \Delta t_t$;

(m3) $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2 + \delta \ln(\Delta t_t)$;

(m4) $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 ind(-\varepsilon_{t-1}) + \gamma \sigma_{t-1}^2 + \delta \ln(\Delta t_t)$;

(m5) $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 ind(-\varepsilon_{t-1}) + \gamma \sigma_{t-1}^2$.

Here $ind(x) = 1$ if $x < 0$ and $ind(x) = 0$ if $x \geq 0$. $\Delta t_t = delta_t$ is difference in days between observation t and observation $t-1$. Weekends and national holidays in US, Japan and Russia are deleted from the data, thus in total we have 2382 observations for the period 2000:01–2010:10. Descriptive statistics of the variables are reported in Table 1.

Table 1. Descriptive statistics of daily returns and Δt, 2000:01–2010:10

	R_MICEX	*R_SNP*	*R_WTI1*	*R_NIKKEI*	*delta*
Mean	0.000898	0.0000594	0.000404	–0.000193	1.53
Median	0.001660	0.000695	0.000351	0.000000	1.0
Maximum	0.252261	0.097743	0.212765	0.132346	12.0
Minimum	–0.206571	–0.094695	–0.172169	–0.121110	1.0
Std. Dev.	0.025133	0.014005	0.026670	0.016491	1.09
Observations	2382	2382	2382	2382	2382

3. Estimates of different models

Specifications m2, m3, m4 take into account the hypothesis that conditional variance σ_t^2 (uncertainty of the market) increases with the time delay between two consecutive observations. Estimates of the equation (1) with various models m0–m5 for the error term are presented in Table 2.

Surprisingly estimates of the coefficients of equation (1) do not depend on the error model choice m0–m5. The variation of coefficients between different models is within one standard deviation with the exception of NIKKEI in OLS model m0.

Table 2. Estimates of equation (1) with error specifications m0–m5 in the period of 2000:01–2010:10*

Dependent Variable: *R_MICEX*	m0	m1	m2	m3	m4	m5
Variable	OLS	GARCH(1,1)	GARCH(1,1) +delta	GARCH(1,1) +ln(delta)	TGARCH(1,1) +ln(delta)	TGARCH(1,1)
R_MICEX(–1)	–0.0925	–0.0841	–0.0810	–0.0813	–0.0802	–0.0818
	(0.0206)	(0.0210)	(0.0212)	(0.0212)	(0.0211)	(0.0211)
R_SNP(–1)	0.1557	0.1501	0.1642	0.1614	0.1624	0.1499
	(0.0403)	(0.0321)	(0.0330)	(0.0331)	(0.0334)	(0.0324)
R_WTI1(–1)	0.0538	0.0575	0.0555	0.0563	0.0560	0.0569
	(0.0187)	(0.0156)	(0.0149)	(0.0150)	(0.0150)	(0.0156)
R_NIKKEI	0.4664	0.3215	0.2872	0.2909	0.2872	0.3177
	(0.0331)	(0.0205)	(0.0235)	(0.0230)	(0.0232)	(0.0211)
Variance						
RESID(–1)^2		0.1207	0.1297	0.1283	0.0928	0.0904
		(0.0098)	(0.0108)	(0.0108)	(0.0131)	(0.0126)
RESID(–1)^2*(*RESID*(–1)<0)					0.0599	0.0478
					(0.0149)	(0.0143)
GARCH(–1)		0.8583	0.8505	0.8500	0.8489	0.8597
		(0.0107)	(0.0118)	(0.0119)	(0.0123)	(0.0109)
delta			3.50E–05			
			(0.45E–05)			
ln(*delta*)				8.39E–05	8.67E–05	
				(0.98E–05)	(0.97E–05)	
Log likelihood	5549.2	5958.4	5988.8	5982.8	5987.4	5961.6
R^2	0.123	0.113	0.109	0.110	0.110	0.113

*) All coefficients are significant at 1% level. Standard errors are in parenthesis. Estimates of constants in main and in variance equations are not presented in the table.

Interpretation of the model m2 coefficients is as follows: 1% increase of S&P return imply 0.16% increase of MICEX return, 1% increase of NIKKEI return imply 0.28% increase of MICEX return, 1% increase of WTI return imply 0.056% increase of MICEX return, and 1% of MICEX return imply 0.081% decrease of the next day MICEX return (overshooting). In our view it is not quite correct to compare which variable is more important by using these numbers, because variations of returns are different (Table 1). It would be more correct to compare products of the returns standard deviations of the corresponding coefficients. Thereby for MICEX, SNP, WTI, NIKKEI we have, respectively, –0.0020, 0.0023, 0.0015, 0.0047, which means that NIKKEI has the largest impact, next are SNP and MICEX, the last is WTI. Note, that as we will see later, the coefficients of the model vary over time and it is not informative to extend these comparisons to the whole period.

From the variance equation we derive that shocks are persistent, since sums $\alpha_1 + \gamma$ in GARCH, or $\alpha_1 + \alpha_2 + \gamma$ in TGARCH are close to 1. Influence of the time delay Δt between observations is statistically significant and positive: the larger Δt the larger is the uncertainty σ_t^2. For $\Delta t = 2$ contribution of Δt to the variance is larger than the average contribution of ε_{t-1}^2 to the variance[3].

A significant positive coefficient α_2 in asymmetric TGARCH models m3, m4, proves that negative news adds more volatility then positive news.

Estimates of the volatility std01–std05 (estimated standard deviations $\hat{\sigma}_t$) with GARCH models m1–m5 are not significantly different from one another. Figure 1 presents scatter plots of std02–std05 against std01 (almost diagonal), and Figure 2 presents plots of std01–std05 against time.

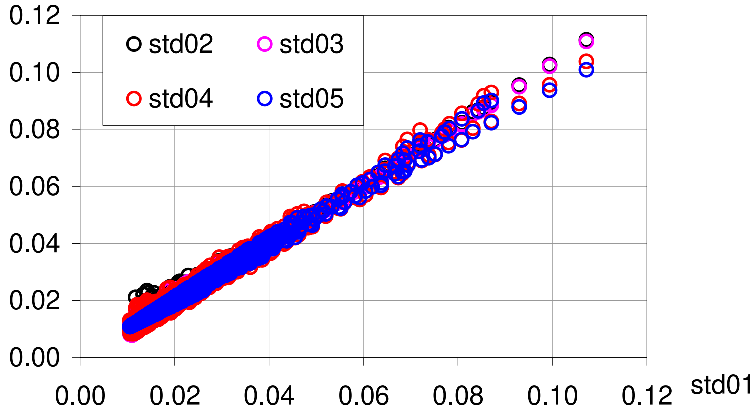

Figure 1. Scatter plots of std02–std05 against std01

[3] Average value of $\hat{\varepsilon}_t^2$ is about 0.00056.

There are a lot of spikes in the volatility plot (Figure 2). Some of them might be related to political news (arrests of Yukos top managers P. Lebedev on July 2, 2003, and M. Khodorkovsky on October 25, 2003), some are related to economic news, like Russian "credibility" banking crisis in summer, 2004, the largest are related to the international financial crisis which began at the end of 2008 in Russia and to the war with Georgia, August 8, 2008.

Another political event — rough criticism by Russian prime minister V. Putin of Mechel, one of the leading Russian companies, on July 24, 2008 — resulted in a collapse of the Russian stock market by \$58 billions on July 25, 2008: MICEX index dropped by 5.5% and Mechel stocks by 29.6%, but that event is not even visible in the Figure 2.

4. Estimates of models in rolling windows.

In order to study evolution of the coefficients of equation (1) in time, we make the following calculations. For each t ($t > 241$) equation (1) is estimated over the interval $(t-240, t)$, approximately 1 year of observations, and estimated coefficients $\beta_i(t)$, $i = 1,...,5$, $t = 241,...,2382$ and their standard errors are recorded. As we discussed above we prefer present results for "normalized" coefficients, that is, say, $\beta_2(t)$, the coefficient at S&P return is multiplied by sample standard deviation of S&P returns over the interval $(t-240, t)$. The product is denoted $nR\_SnP(-1)$. The plots of the coefficients $\beta_i(t)$ "normalized" in such a way, are presented in Figure 3. Plotted are only values of coefficients, statistically significant at 5% level. So long as coefficients estimates with OLS and GARCH models produces very similar plots presented are results from OLS estimates along with R^2 plot (right scale).

From Figure 3 it is possible to conclude that: first, oil prices (WTI) were significant only until the year 2006; second, the previous day return of the Russian index (MICEX) became significant only after spring 2006; third, the US index (S&P) was significant in almost all time periods before the crisis in August 2008, and after recovering since spring 2010; fourth, the Japan index (NIKKEI) was significant during the whole period of observations; fifth, the "degree of influence", measured as "normalized" coefficients, were approximately equal during quiet periods for US, Japan, and oil indices and all of them were higher than the influence of the lagged Russian index (MICEX).

Drops in the goodness-of-fit measure (R^2) from 0.15 to 0.05 were observed in the period of mid-2003–mid-2005. The reason for that discrepancy between Russian and world markets during that period is not quite clear. The jump of the goodness-of-fit measure and the "degree of influence" of the Japan index during the crisis period of 2008:10–2009:10 has only a “technical” econometrics explanation: the reason is high market return values and volatility at this period.

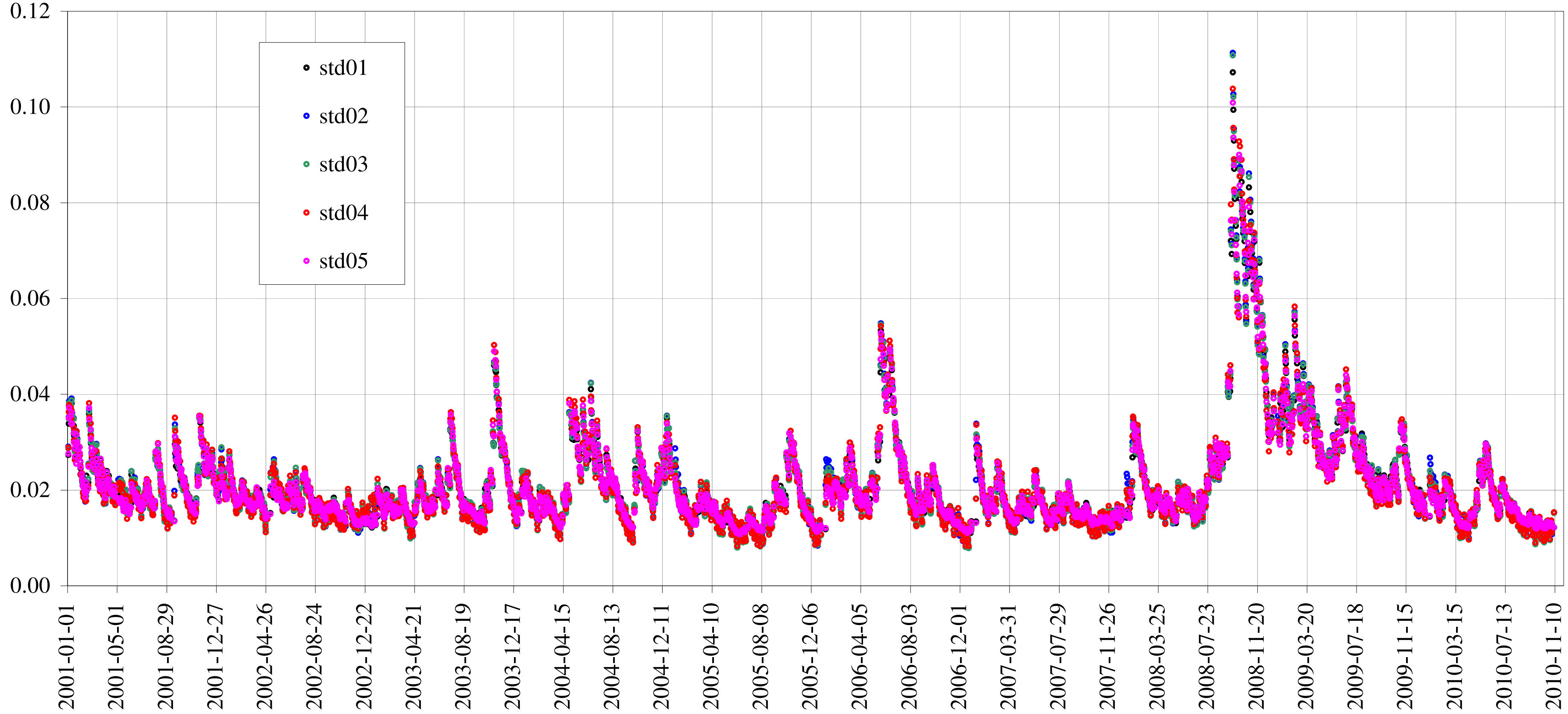

Figure 2. Evolution of the volatility over time

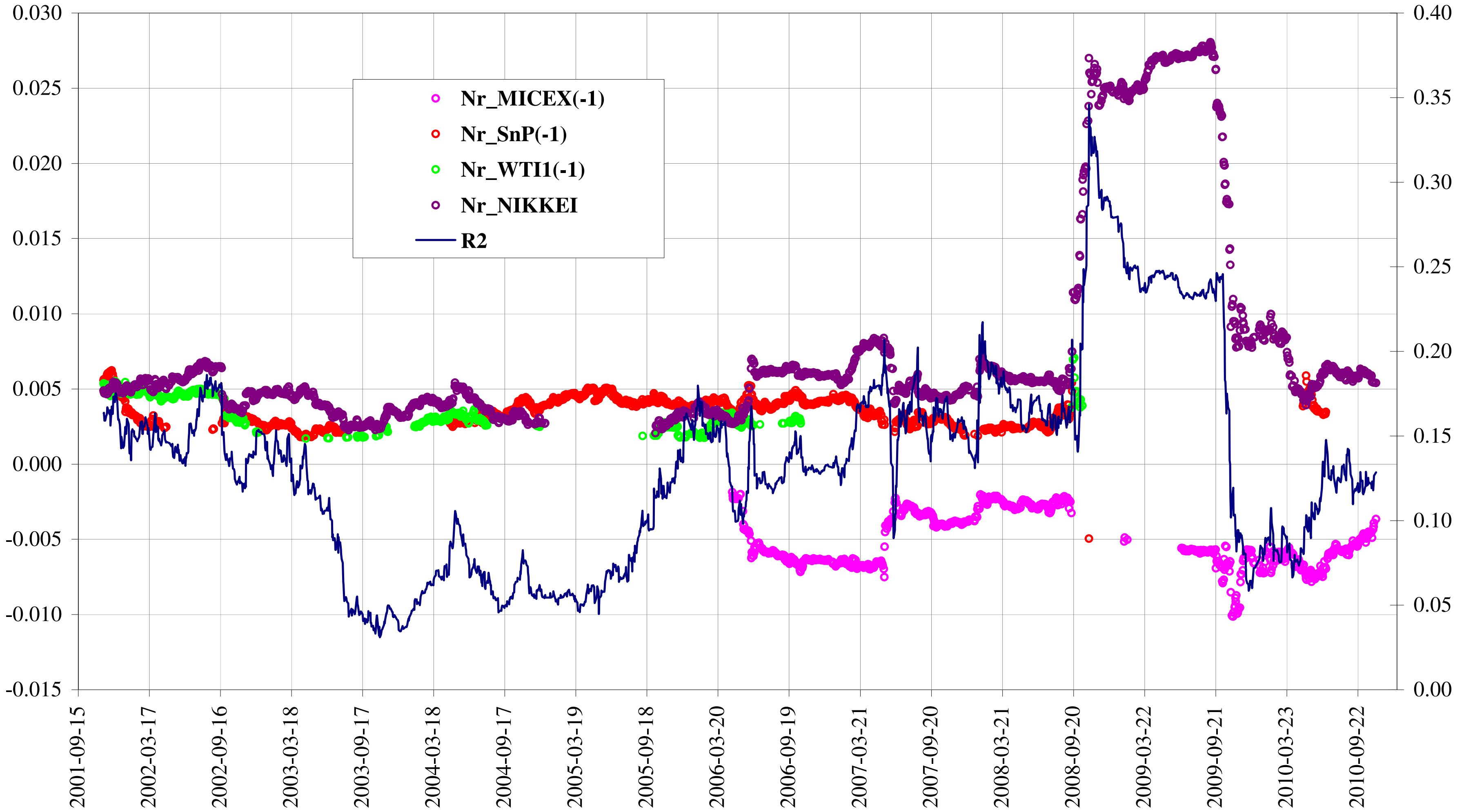

Figure 3. Evolution of coefficients of equation (1) (left scale) and goodness-of fit measure R^2 (right scale) over time

4.1. Estimates of models in rolling windows with "forecasted" indices

There is some problem of using lagged values of the US indices S&P and WTI in the equation (1), because of the long gap between the closing times of the US market at day $t-1$ and of the Russian market at day t. In that approach some news are not incorporated in US indices. We test the following hypothesis: investors in the Russian stock market are looking not at the previous day US returns indices R_SNP_{t-1}, R_WTI_{t-1}, but they use some models to forecast next day values $R\_SNP\_f_t$, $R\_WTI\_f_t$, and use them in equation (1), which then becomes

$$R\_MICEX_t = \beta_0 + \beta_1 R\_MICEX_{t-1} + \beta_2 R\_SNP\_f_t + \beta_3 R\_WTI\_f_t + \beta_4 R\_NIKKEI_t + \varepsilon_t, \quad (2)$$

The forecasts could use all information available at the opening time of the Russian stock market information. As examples of such models for US indices forecasting we have chosen the equations:

$$\begin{aligned} r\_snp_t = {} & \beta_0 + \beta_1\, r\_snp_{t\text{-}1} + \beta_2\, r\_snp_{t\text{-}2} + \beta_3 r\_wti_{t\text{-}1} + \beta_4 r\_nikkei_t \\ & + \beta_5\, r\_rts_{t\text{-}1} + \beta_6 r\_ftse_{t\text{-}1} + u_t, \end{aligned} \quad (3)$$

$$\begin{aligned} r\_wti_t = {} & \beta_0 + \beta_1 r\_wti_{t\text{-}1} + \beta_2 r\_wti_{t\text{-}2} + \beta_3 r\_brentind_{t\text{-}1} \\ & + \beta_4\, r\_brentind_{t\text{-}1} + \beta_5 r\_snp_{t\text{-}1} + \beta_6 r\_dji_{t\text{-}1} + \beta_7 r\_ftse_{t\text{-}1} + v_t, \end{aligned} \quad (4)$$

where $ftse$ is FTSE 100 price index, dji — Dow Jones Industrials price index, $brentind$ — London Brent Crude Oil Index[4].

Again as above we estimate equation (2) in rolling windows of size 241: $(t-240, t)$ predicted values of $R\_SNP\_f_t$, $R\_WTI\_f_t$ are calculated for each t from the equations (3) and (4), estimated at the intervals $(t-50, t)$ (windows of size 101 also were tested). The results were not that good. Predictive power doesn't increase. Only the NIKEI and lagged MICEX were significant over the same periods for equation (2). Occasionally forecasted values $R\_SNP\_f_t$, $R\_WTI\_f_t$ were also significant, but in many cases with the "wrong" (negative) sign.

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[4] FTSE100, LCRINDX, and LCRINDX from Datastream.

5. Rolling windows and event dummy

In this section we study abnormal returns and abnormal volatilities in equation (1). Since we suppose that all external shocks are absorbed by US, Japan, oil indices, all the rest may be related to endogenous (internal) shocks in the Russian market, which are generated by specific Russian political or economic news.

We suggest the following procedure. Equation (1) with an additional dummy is estimated in rolling windows of length 201: $(t-200, t)$, $201 < t < 2832$:

$$R\_MICEX_t = \beta_0 + \beta_1 R\_MICEX_{t-1} + \beta_2 R\_SNP_{t-1} + \beta_3 R\_WTI_{t-1} + \beta_4 R\_NIKKEI_t,$$
$$+\gamma_\tau eventdummy_{t\tau} + \varepsilon_t, \qquad (5)$$

where $eventdummy_{t\tau} = \begin{cases} 1, & \tau - L \le t \le \tau + L, \\ 0, & otherwise, \end{cases}$ is the indicator function of the event window of length $2L+1$, with the center at the point τ. The center point was chosen such that the right boundary point of the event window is $t-10$, that is the event window is placed at the end of the rolling window. We tested event windows of size 1, 3, 5, 7. Thus, significant coefficient γ_τ indicates that there is an endogenous shock in Russian index returns on some day around day τ, which could not be forecasted by the model (1) estimated on the history of (approximately) 200 observations.

Different event windows lengths produce similar results, indicating endogenous shocks at the same points in time, the number of the revealed shocks increase with the length of the event window. Figure 4 presents the results of the LS estimates[5] of the equation (5) for the rolling window of length 200 and event window of length 3 $(L=1)$. The points of the plot are estimated values of the coefficient $\hat{\gamma}_\tau$, the horizontal axis is time of the event, τ. Statistically significant values are marked with circles. The triangles mark the days related to the Yukos affair: arrest of P. Lebedev, and the next day (July 2–3, 2003), and the arrest of M. Khodorkovsky, and the next day (October 25–26, 2003). There are a lot of shocks, and not necessarily the largest values of $\hat{\gamma}_\tau$ are statistically significant. Most of the shocks are in the pre-crisis period.

The magnified versions of the Figure 4 plots are presented at Figure 5 (around Yukos arrests), and the Figure 6 (around beginning of the 2008 crisis). The days related to the Lebedev arrest are not significant, four significant points were marked 1 and 2 weeks after the arrest. Khodorkovsky's arrest represents a different situation: the day after the arrest is marked as negative significant. In addition there are 5 more negative significant events — two before Khodorkovsky's arrest and 3 after. It looks as if the Russian market previewed the events.

[5] GARCH estimates provide similar results.

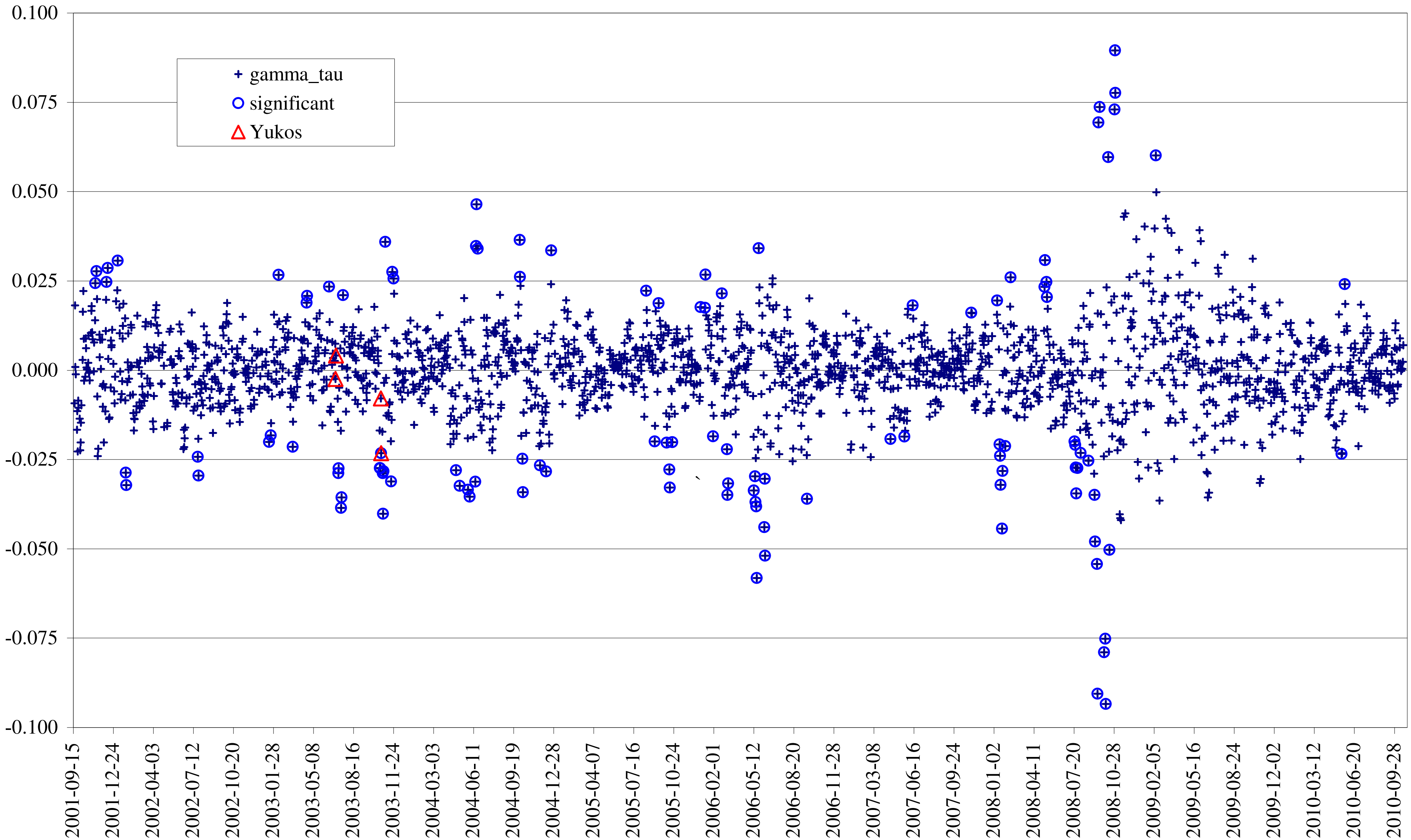

Figure 4. Plot of the significant event dummies

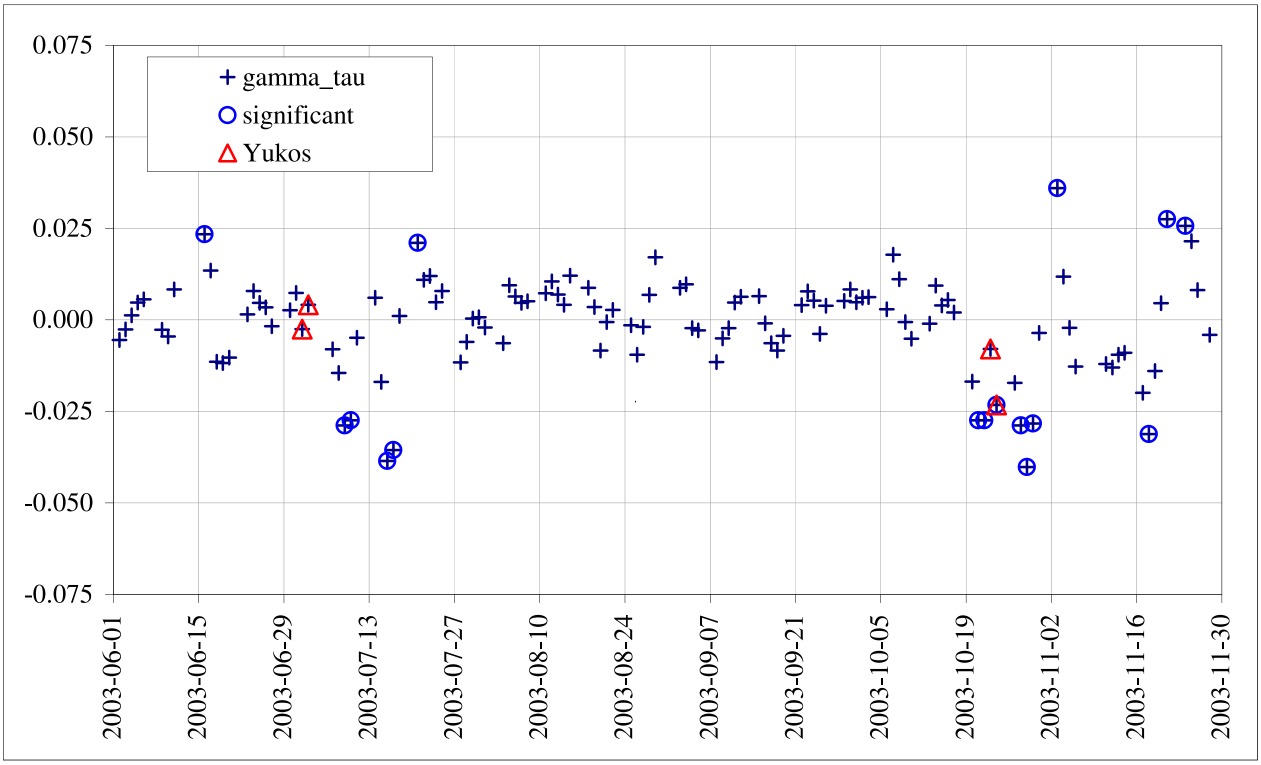

Figure 5. Yukos arrests

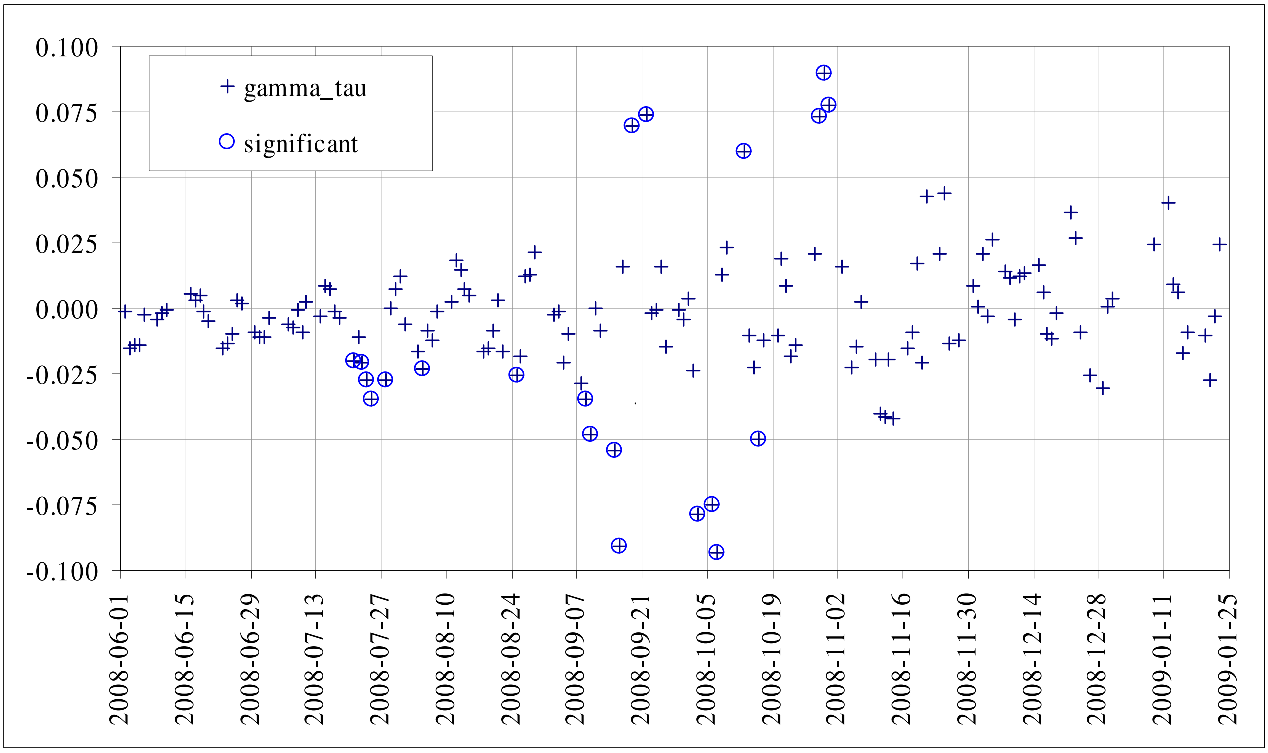

Figure 6. The 2008 crisis

To find events with significant impact on market volatility we carry out the same procedure as above estimating the equation (1), but now we use the TGARCH model m4, including an event dummy directly in the variance equation:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-1}^2 ind(-\varepsilon_{t-1}) + \gamma \sigma_{t-1}^2 + \delta \ln(\Delta t_t) + \gamma_\tau \, eventdummy_{t\tau} . \tag{6}$$

Figure 7 presents the results of estimates of the equation (1)-(6) for the rolling window of length 200 and the event window of length 3 $(L = 1)$. The points of the plot are estimated values of the coefficient $\hat{\gamma}_\tau$, the horizontal axis is time of the event, τ. We can see significant outbreaks of abnormal volatility near to the Yukos arrests and related to the beginning of the 2008 crisis. Most of the statistically significant coefficients are negative and are related to news, which decreases the volatility. Magnified versions of the Figure 7 plots are presented in Figure 8 (around Yukos arrests), and Figure 9 (around beginning of the 2008 crisis). One can observe positive shocks during the two weeks after Lebedev's arrest and positive shocks around Khodorkovsky's arrest. Some of those shocks were before the arrest, it looks like the event was foreseen by the market. Positive shocks in volatility related to the 2008 crisis started on August 28, 2008. That could be a market reaction to president Medvedev's announcement on August 26, that Russia unilaterally recognizes the independence of the former Georgian breakaway republics Abkhazia and South Ossetia.

6. Conclusions

We have found statistically significant influence of oil prices on Russian stock index returns. This dependence vanished after 2006. Also the US market index (S&P500) has some predictive power for the Russian market index with the exception of the very volatile period during the 2008-2009 crisis. The Japan index NIKKEI is significant during the whole period of observations, the reason is that the Japan market is the nearest one preceding the Russian market in terms of closing time, and hence it absorbs the latest news from world markets.

With moving dummies in the returns equation and in the variance equation we detect abnormal endogenous shocks. Some of them could be related to Russian political news, but there are many others (even larger in size) that we failed to tie to some political or economic news. This confirms the conclusion (Anatolyev, 2005) on structural instability of the Russian financial market.

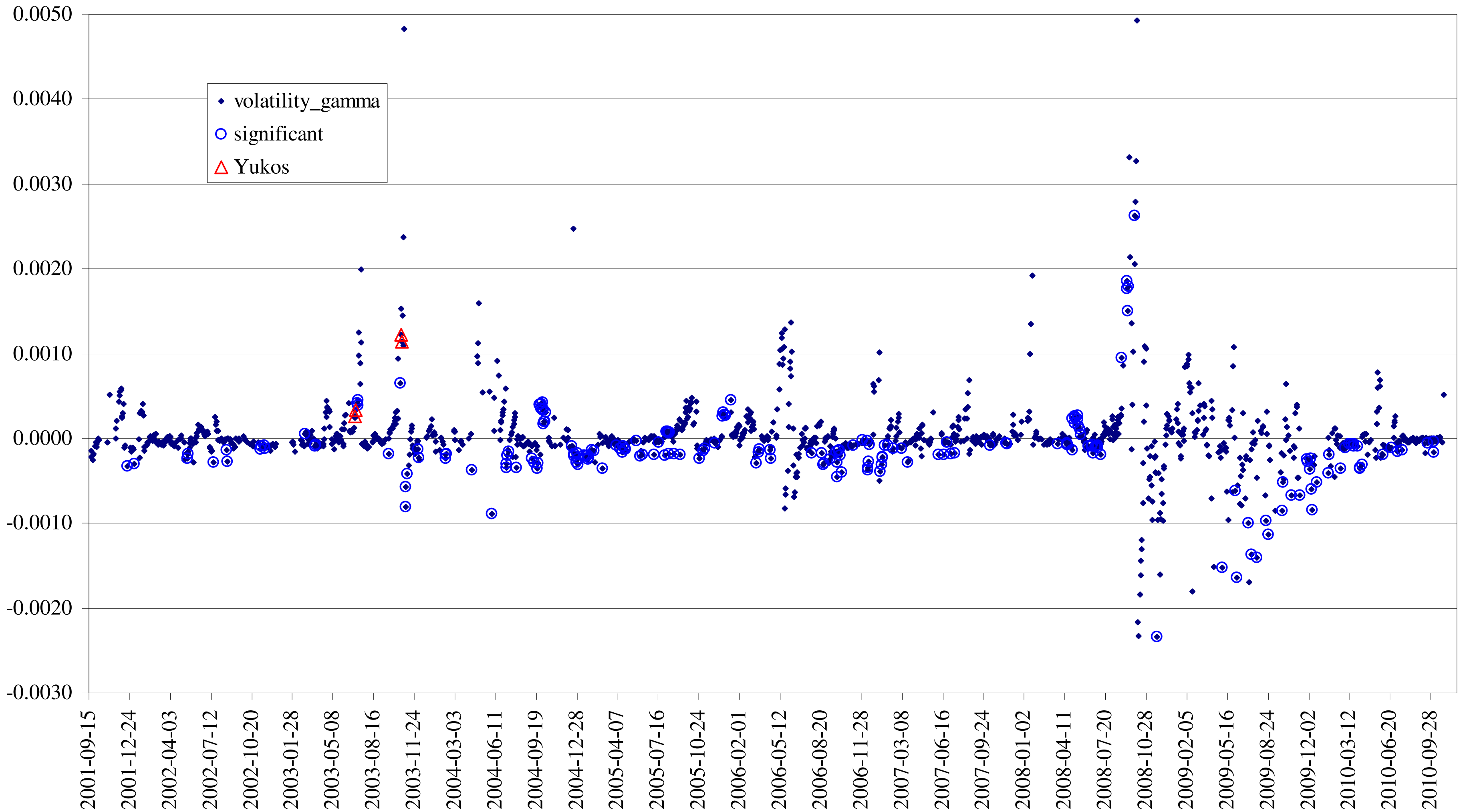

Figure 7. Plot of the significant for the abnormal volatility event dummies

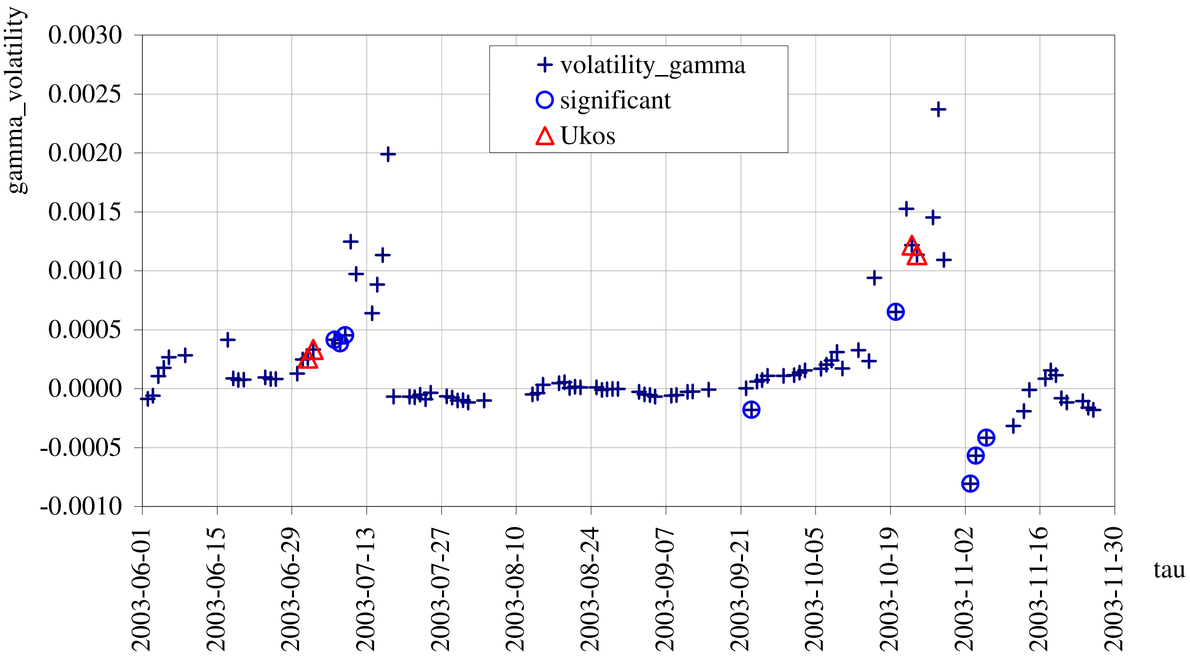

Figure 8. Abnormal volatility. Yukos arrests

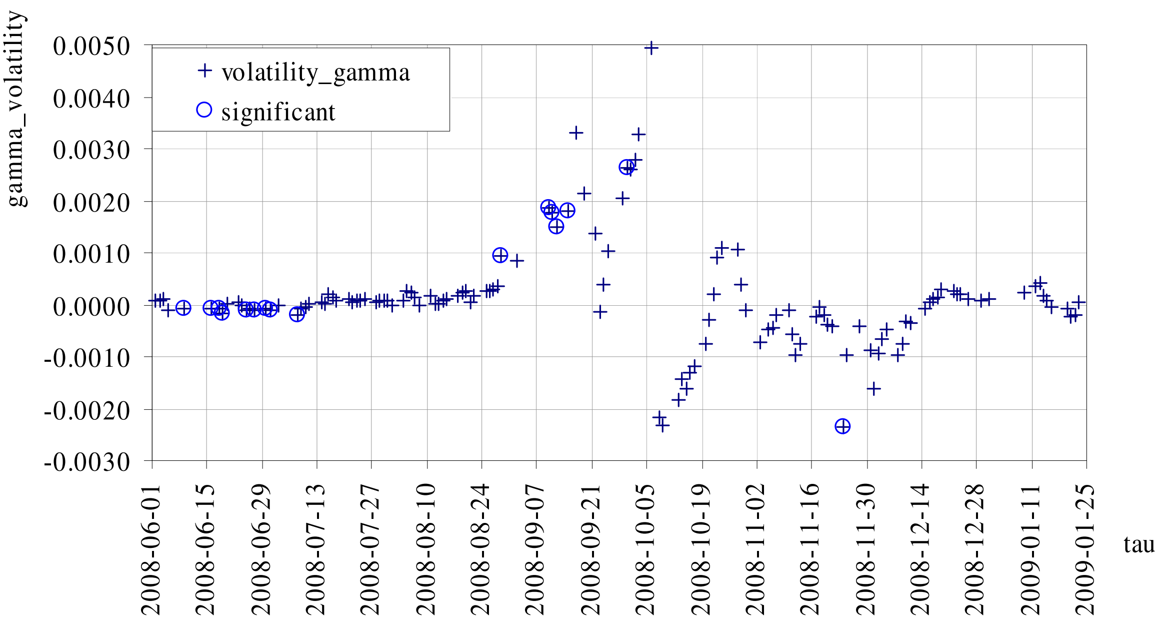

Figure 9. Abnormal volatility. Crisis

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