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The Spillovers between the Russian and Other Asian and European Stock Markets A Multivariate GARCH-in-Mean Analysis

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SPILLOVERS BETWEEN THE RUSSIAN AND OTHER ASIAN AND EUROPEAN STOCK MARKETS: A MULTIVARIATE GARCH-IN-MEAN ANALYSIS

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Abstract

This paper uses a VAR-GARCH-in mean framework with a BEKK representation to examine spillovers between the Russian and other Asian and European markets, distinguishing between emerging and developed markets. The aggregate estimates suggest the presence of mean spillovers from Europe towards Russia during the crisis period only, whilst there are volatility spillovers from both Europe and Asia. There are also GARCH-in-mean effects from the developed Asian markets and volatility spillovers from the emerging ones. As for the European markets, there are mean spillovers towards Russia from the developed ones and volatility spillovers from the emerging ones. Concerning spillovers in the opposite direction, i.e. from the Russian market, there is evidence of both mean and volatility spillovers affecting both types of Asian markets (though the emerging ones to a greater extent), but only the emerging ones in the case of Europe.

Keywords: Russian stock market, spillovers, VAR-GARCH-in-mean, BEKK representation

JEL Classification: G15, C32

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1. Introduction

There is plenty of evidence suggesting that stock market spillovers play an important role in both normal and turmoil periods (see, e.g., Caporale et al., 2005, 2006). This paper focuses on the linkages between the Russian and other Asian and European stock markets, providing new empirical evidence that is of interest to both academics and investors. Consider, for instance, a Russian trader dealing in derivatives, whose price is affected by the volatility of the underlying asset, who should decide whether to adopt a positive or negative vega strategy, which are appropriate for periods of high and low volatility respectively. If there are spillovers from some other highly volatile Asian stock market that the trader is not aware of, he might wrongly bet on low volatility and choose a negative vega strategy, and will transmission channels. Beirne et al. (2010) find in most cases spillover effects from regional and global stock markets to local emerging ones, but the relative importance of global and regional markets as well as of the different transmission channels differ across regions. In the case of Russia, they conclude that mean spillovers are not present, but they find evidence of own and cross-market GARCH-in-mean as well as variance spillovers. Beirne et al. (2013) study spillovers and contagion for emerging market economies and conclude that volatility spillovers exist for almost all countries, including Russia. Caporale and Spagnolo (2010) investigate the integration of the stock markets of the CEECs, Russia and the UK and find evidence of both mean and volatility spillovers from Russia to the CEECs. Ločmelis and Mititel (2015) study interdependence between the Russian, EU and US stock markets during the 2014-2015 Russian crisis, and find mean spillovers from the EU and US stock markets to the Russian one estimating impulse response functions, and also that volatility spillovers towards the Russian stock market strengthened during the crisis. All these papers use VAR-GARCH-in-mean specifications with the BEKK representation proposed by Engle and Kroner (1995).

A more recent paper by Oikonomiku (2016) employs instead a VAR-EGARCH model to examine mean and volatility linkages between four countries including Russia. He finds that there are bidirectional linkages between mean returns in the Russian stock market and those of the Czech Republic, Poland and Ukraine, and that the volatility of Russian stock prices is highly persistent. However, his EGARCH specification does not allow for GARCH-in-mean effects.

One important issue is the distribution followed by the error term in the mean equation, since non-normality makes the estimates of the standard errors (and therefore statistical inference) invalid. Beirne et al. (2010, 2013) address it by using the quasi-maximum likelihood (QML) estimator of Bollerslev and Wooldridge (1992), which is robust specification based on the normality assumption owing to the fat tails of the return distributions.

3. Empirical Framework

3.1 The Model

To test for own and cross-market spillover effects a VAR-GARCH(1,1)-in-mean with a BEKK representation is used. In particular, the following three models are estimated:

i) Model 1 examines spillovers vis-à-vis other Asian and European stock markets. The adopted VAR-GARCH(1,1)-in-mean specification is the following:

= (1)

where is a trivariate vector including stock returns for Russia and other Asian and European markets, is a vector of constants; is the conditional variance-covariance matrix of stock index returns; is a matrix of coefficients representing the GARCH-in-mean effects, and the effects of own-market and cross-market variances on returns in the Russian stock market assuming that their volatility does not affect mean returns in Asia and Europe; is a vector including US stock returns and the 90-day US Treasury Bill rate as control variables in the mean equation; is a 2x3 matrix whose coefficients measure the effects of changes in the control variables on market returns. The coefficients in the matrix ***B*** in upper case letters are defined as follows:

(2)

(3)

(4)

where and are the coefficients of a dummy variable with a switch on 15 September 2008, the day when Lehman Brothers collapsed; this allows for a possible structural break at the onset of the global financial crisis.

For the conditional variance-where is the number of degrees of freedom of the multivariate t-distribution, n is the number of equations in the VAR system or the number of rows of the vector $\boldsymbol{x_t}$, and (.) is the usual gamma function. The model is estimated by maximising the log-likelihood function with respect to the vector of parameters . This function is shown below (see Rossi and Spazzini, 2008 for more details on this estimation method):

(7)

ii) Model 2 examines spillovers vis-à-vis a number of Asian stock markets

The relevant hypotheses are the following in the case of *Model 1*:

Mean spillovers

H01: No spillovers in mean from Asia to Russia: .

H02: No spillovers in mean from Europe to Russia: .

H03: No spillovers in mean from Asia and Europe to Russia:

H04: No spillovers in mean from Russia to Asia:

H05: No spillovers in mean from Russia to Europe:

Volatility spillovers

H06: No volatility spillovers from Asia: .

Asia: China, Hong Kong, India, Indonesia, Israel, Japan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Thailand;

Europe: Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom.

The data source is Thompson Reuters Datastream. Weekly returns are calculated in domestic currency as:

(11)

where stands for returns in country i in week t, average. Ideally one would have used instead stock market capitalisation to determine the weights, but this was not available for most countries.

In Model 2 the Asian countries in the sample are divided into two groups:

1) Emerging markets: China, India, Indonesia, Pakistan, Philippines, Thailand;
2) Developed markets: Hong Kong, Israel, Japan, Malaysia, Singapore, South Korea.

and aggregate returns for each subset are calculated as before.

Similarly, in Model 3 the European countries are divided into the two following groups:

1) Emerging markets: Croatia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Romania, Turkey, Ukraine;
2) Developed markets: Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom.

and again aggregate returns are constructed as before.

The return series are plotted in Figures 1, 2, and 3 in the Appendix. The impact of the global financial crisis in September/October 2008 is clearly visible and motivates the inclusion of a switch dummy to model this structural break. Descriptive statistics are reported in Table 1. In all cases mean returns are close to zero and exhibit large kurtosis with negative skewness; the Jarque-Bera test statistics imply rejection of the null of normality in all cases. Therefore, as already mentioned, we use a Student's t-distribution instead.

4.2 Empirical Results

The estimation results for *Model 1* are reported in Table 2 and 3. Most coefficients in the mean equation are not significant; however, there is evidence of European returns affecting the Russian ones during the crisis period only, and of both Russian and US returns affecting the Asian ones. The US T-bill rate is also insignificant. As for the conditional variance equation, volatility appears to be highly persistent in all three markets, and most coefficients are significant, but there is no evidence of volatility spillovers from the Russian to the other stock markets.

The Wald test statistics are reported in Table 8 and 9. We find some evidence of spillovers from European mean returns to the Russian ones (H02), but only in the crisis period, and of spillovers from Asia as well (H01), whilst the joint null of mean spillovers from Asia and Europe is rejected (H03). By contrast, the joint null of volatility spillovers from Asia and Europe towards Russia (H08) cannot be rejected; the null of no spillovers from Asia (H06) and Europe (H07) can be rejected at the 5% and 10% level respectively.

References

Bae, K.-H., Karolyi

Engle, R.F. and K.F. Kroner, 1995, Multivariate Simultaneous Generalized ARCH , *Econometric Theory*, 11: 122-150.

Giller, G., 2005, "A generalized error distribution", *SSRN Electronic Journal*

King, M., Wadhwani, S., 1990. "Transmission of volatility between stock markets", *Review of Financial Studies* 3 (1), 5-33.

Liu, Y.A. and M.S. Pan, 1997, "Mean and Volatility Spillover Effects in the U.S. and Pacific- Asian Stock Markets," *Multinational Finance Journal*, 1, 47-62.

Ljung, G.M., Box, G. E. P., 1978. "On a measure of lack of fit in time series models", *Biometrika* 65, 297-303.

Ločmelis, K. and D. Mititel, 2015, " Impact of Russia's 2014–2015 Crisis on the Dynamic Linkages between the Stock Markets of Russia, the EU and U.S." , Bachelor Thesis, SSE Riga.

Oikonomikou, L. E.,2016, "Modeling financial market volatility in transition markets: A multivariate case, Courant Research Centre: Poverty, Equity and Growth", Discussion Papers, No. 204

Rossi, E. and F. Spazzini, 2008, "Model and distribution uncertainty in Multivariate GARCH estimation: a Monte Carlo analysis", Quaderni di Dipartimento, EPMQ, Università degli Studi di Pavia, No. 208

Saleem, K. (2008), "International linkage of the Russian market and the Russian financial crisis: A multivariate GARCH analysis", *BoFit Discussion Papers*.

Theodossiou, P. and U. Lee, 1993, "Mean and Volatility Spillovers across Major National Stock Markets: Further Empirical Evidence", *Journal of Financial Research*, 16, 337-350.

Walti, S., 2003, "Testing for Contagion in International Financial Markets: Which Way to Go?", *FAME Working Paper* No. 92.

Worthington, A., Higgs, H., 2004. "Transmission of equity returns and volatility in Asian

Appendix

Figure 1:

Table 2: Parameter estimates for the mean equation of *Model 1*

Table 6: Parameter estimates for the mean equation of *Model 3*