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A ten-year retrospection of the behavior of Russian stock returns

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BOFIT Discussion Papers
Editor-in-Chief Iikka Korhonen

BOFIT Discussion Papers 9/2005
15.7.2005

Stanislav Anatolyev:
A ten-year retrospection of the behavior of Russian stock returns

ISBN 952-462-784-1
ISSN 1456-4564
(print)

ISBN 952-462-785-X
ISSN 1456-5889
(online)

Multiprint Oy
Helsinki 2005

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Tiivistelmä

Tutkimuksessa käsitellään Venäjän osakemarkkinoita kolmesta eri näkökulmasta: mitkä tekijät vaikuttavat osakkeiden tuottoihin, minkälainen on Venäjän osakemarkkinoiden integraatio maailman muiden pääomamarkkinoiden kanssa, ja ovatko markkinat tehokkaat. Aineisto ulottuu vuodesta 1995 nykyhetkeen, ja tutkimuksen pääpaino on siinä, miten nämä Venäjän osakemarkkinoiden eri osatekijät ovat muuttuneet ajan kuluessa. Yleisesti ottaen erilaisten muuttujien väliset suhteet ovat varsin epävakaita, ja Venäjän osakemarkkinoilla on ollut useita hyvinkin epävakaita ajanjaksoja. Vaikka useimmat lasketut tilastolliset tunnusluvut vaihtelevat ajan kuluessa, viime aikoina Venäjän osakemarkkinoilla on ollut havaittavissa varsin selviä kehityssuuntia: osakkeiden tuottoja pystytään nykyään selittämään paremmin, kansainväliset pääomamarkkinat vaikuttavat aiempaa enemmän, ja Venäjän osakemarkkinat toimivat tehokkaammin kuin ennen.

A ten-year retrospection of the behavior of Russian stock returns

by

Stanislav Anatolyev

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Acknowledgements: This work was done during a stint as a visiting researcher at the Bank of Finland Institute for Economies in Transition (BOFIT). I am grateful to the participants of BOFIT seminars, especially Iikka Korhonen and Jouko Rautava, for helpful discussions. I thank BOFIT and its staff for providing an excellent research environment. Andrey Shabalin was a great help in processing the data.

Key words: Russia, transition, stock returns, integration, efficiency.

JEL codes: C22, F36, G14, G15.

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Abstract

We study three aspects of the Russian stock market – factors influencing stock returns, integration of the stock market with world financial markets, and market efficiency – from 1995 to present, putting emphasis on how these evolved over time. We find many highly unstable relationships, and indeed, greater instability than that generated by financial crises alone. While most computed statistics exhibit constant ups and downs, there are recently clear tendencies in the development of the Russian stock market: a sharp rise in explainability of returns, an increased role of international financial markets, and a decrease in the profitability of trading.

1 Introduction

In the handful papers that consider the Russian financial market at the aggregate level (e.g., Gelos and Sahay, 2001; Jithendranathan and Kravchenko, 2002; Lucey and Voronkova, 2004; Hayo and Kutan, 2005), it is generally presumed that, apart from the period of the Russian financial crisis of 1998 and possibly a few other crises, relationships in the market have been temporally stable. At the same time, it is documented that relationships in developing financial markets, particularly those in post-communist countries, have evolved differently (e.g. Zalewska-Mitura and Hall, 1999; Rockinger and Urga, 2000).

In this paper, we conduct a systematic investigation of three aspects of the Russian stock market at the aggregate level over the past ten years. First, we study how various macroeconomic and financial variables, both global and domestic, have impacted Russian stock returns and how this impact has changed over time. We specially construct a variable to reflect the political riskiness or attractiveness of the Russian stock market. Second, we track indicators of integration of the Russian stock market with world financial markets. Third, we take a look at its efficiency and the profitability of trading by a virtual investor. To accomplish these goals, we compute various statistics of interest within a window of one year of data, with this window moving in time from early 1995 to late 2004–early 2005. The figures showing how the statistics of interest vary across time provide an interesting picture of the development of the stock market in Russia. We find tracking the statistics of interest over time in this manner is better suited to the constantly changing environment of a developing financial market than the popular methodology of identifying structural breaks at unknown dates developed by Bai and Perron (1998), which is often applied to developed markets (e.g. Rapach and Wohar, 2004).

In our analysis, we strive to use the simplest parametric models (and even nonparametric methods), because, in our view, the strong assumptions underlying, say, the ARCH models used in Rockinger and Urga (2000) and Hayo and Kutan (2005), do not necessarily hold in a constantly changing environment. Moreover, our modest sample sizes preclude reliable inference of complicated parametric models. For the particular study of how stock returns have been determined, we use a linear regression analysis.

To see how the degree of market integration evolved over the period, we construct nonparametric "realized correlation" measures of co-movements from high-frequency (daily) returns data.

Finally, to study the question of efficiency of the Russian stock market, we employ a nonparametric test of mean predictability, and look at the profitability of trading by a virtual investor.

The results yield substantial evidence that the Russian stock market has been afflicted by considerable structural instability, and that this instability has not been confined to one-time events such as the documented financial crises. Moreover, the influence of certain factors on Russian stock returns such as oil prices and foreign exchange rates has diminished, while the influence of other factors such as US stock prices and international and domestic interest rates has increased recently. The explanatory power of domestic and global factors has fluctuated appreciably, with the regression R^2 taking values from mere few percent to as much as 60%. There is no clear positive trend in the degree of integration of the Russian stock market with other stock markets, but in recent years the spillovers coming from other stock markets to the Russian market have increased, while spillovers in the opposite direction having diminished. The co-movements of Russian and world sectoral stock markets also exhibit a varying pattern. They are quite high most of the time, although not necessarily greater for energy markets. The weak-form market efficiency of the Russian stock market is confirmed, and the trading of a virtual investor using publicly observable information is not particularly profitable, even under the assumption of no market limitations and during the periods of strong profitability in 1998 and 1999.

The paper is organized as follows. In section 2, we describe the data. In section 3, we conduct the analysis of factors influencing Russian stock returns, and the evolution of their impact through the years. In section 4, we analyze the evolution of correlations between stock returns in the Russian and other international markets. In section 5, we track the efficiency and profitability of Russian stock returns. Section 6 concludes.

2 Data

Ostrovsky (2003) and section 3 of Lucey and Voronkova (2004) provide succinct overviews of the Russian stock market. Although regional stock exchanges in Russia existed from as early as 1993, the two largest exchanges, the Russian Trading System (RTS) and Moscow Interbank Currency Exchange (MICEX), were launched in mid-1995 and mid-1997, respectively. In addition to the RTS and MICEX indexes, there are several other indexes of the Russian stock market performance composed by various information agencies (AK&M, RBC, S&P-RUX, etc.). The most comprehensive index presumably is the *Morgan Stanley Capital International Inc.* (MSCI) Emerging Markets (EM) index for Russia (expressed in USD), which is also used in Lucey and Voronkova (2004). This index is available from January 2, 1995, when it had an initial value of 100. MSCI index dynamics are shown in Figure 1. We call this variable $msci^{ru}$. The MSCI index offers two advantages: it has the Wednesday data that we use for weekly observations and conforms with the regional and sectoral MSCI indexes.

Along with $msci^{ru}$, the following data are used in further sections of the paper. In studying the determination of Russian stock returns, we employ:

- oil – Brent crude oil price (in USD prices);
- er – ruble/USD official exchange rate (in rubles per USD);
- $msci^{us}$ – MSCI index for USA (in USD prices);
- $tbill$ – 3-month US Treasury bills rate (in percent);
- $mibor$ – 1-month Moscow interbank offer rate (in percent);
- $gold$ – gold reserves kept by the Central Bank of Russia (in USD million);
- $money$ – credit balances of correspondent accounts in the Central Bank of Russia (in billions of rubles).

In addition, we use the following volatility indexes:

- vol^{oil} – index of oil price volatility;
- vol^{er} – index of ruble/USD exchange rate volatility;
- vol^{us} – index of US stock price volatility.

Each volatility index is computed from daily data corresponding to absolute changes occurring during five days preceding the day by which the index is dated. For example, the value of vol^{oil} in week t corresponding to the Wednesday quote is computed as

$$\left|\ln(oil^{wed}) - \ln(oil^{tue})\right| + \left|\ln(oil^{tue}) - \ln(oil^{mon})\right| + \left|\ln(oil^{mon}) - \ln(oil^{last\ fri})\right| \\ + \left|\ln(oil^{last\ fri}) - \ln(oil^{last\ thu})\right| + \left|\ln(oil^{last\ thu}) - \ln(oil^{last\ wed})\right|,$$

where the superscripts are self-explanatory. Similarly constructed indexes of volatility are used, for example, in LeBaron (1992), albeit with squares instead of absolute values. The variables $msci^{ru}$, oil, er, $msci^{us}$, and $tbill$ are available from the beginning of 1995; the variables $mibor$, $gold$, and $money$ from 1999.

In studying the integration of the Russian stock market with international stock markets, we use various other MSCI indexes in addition to $msci^{us}$. Table 1 contains detailed information on the composition of MSCI regional indexes. These cover developed markets for all countries except the US, including developed markets in Europe, developed markets in the Pacific region, as well as emerging markets in Latin America and Asia. Table 2 contains detailed information on composition of MSCI sectoral indexes. These indexes are available from as early as January 1995.

3 Factors influencing Russian stock returns

In this section, we analyze the factors (global and domestic, macroeconomic and financial) driving Russian stock returns, and how the importance of these factors has changed over the years. We apply a linear regression analysis within a moving window containing one year of weekly data, i.e. 52 weekly observations. As a left side variable, we employ the growth rate of $msci^{ru}$. As right side variables, we utilize the indicators listed in the previous section, most in a growth form, along with a specially constructed variable.

There is a universal perception in the Russian financial market that market prices of traded equities do not reflect their underlying fundamental values. Blue chip stocks rarely pay dividends, and when they do, they constitute a tiny fraction of the market price. Capitalization figures, inherited from Soviet era bookkeeping, also likely underestimate the fundamental value of companies. Hence, price fluctuations may reflect more the dynamics of overall economic and political factors than changes in fundamental values. It is widely accepted that the "Yukos case" pushed down prices of Russian stocks in the second half of 2003 in comparison with what would have presumably happened without this case (see Goriaev and Sonin, 2005). As the risk factor is hard to quantify, especially at the going weekly level, we use as a proxy the filtered *JPMorgan* Emerging Market Bond Index Plus for Russia, or $embi^{rus}$ for short, which tracks all of Russia's traded external debt instruments (including Brady bonds, loans, Eurobonds, and local market instruments). In its raw form, however, this variable not only reflects political risks but also contains fundamental movements in the domestic bond and stock markets. Therefore, we first need to filter out the latter factors.

The Johansen cointegration test (both maximum eigenvalue and trace) for the variables $\ln(embi^{ru})$, $\ln(msci^{ru})$, $\ln(msci^{us})$, $\ln(oil)$, and $tbill$, indicate one cointegrating relationship at the 5% significance level. We regress the log of $embi$ on a constant and contemporaneous values of log of $msci^{ru}$, log of $msci^{us}$, log of oil, and $tbill$:

$$\ln(\widehat{embi^{ru}}) = \underset{(0.52)}{3.69} + \underset{(0.045)}{0.800} \ln(msci^{ru}) - \underset{(0.090)}{0.540} \ln(msci^{us}) + \underset{(0.101)}{0.334} \ln(oil) - \underset{(0.0117)}{0.0808}\, tbill$$

(robust standard errors in parentheses), and take minus of the residuals. We call this variable $risk$ and use it as a proxy for the level of political and economic risk. In addition, this variable may also reflect unattractiveness of the Russian stock market for investors because of temporary attractiveness of alternative international stock markets. The dynamics of the variable $risk$ is presented on Figure 2. Even though this variable is quite persistent and does not seem strictly stationary, it apparently no longer contains stochastic trends.

By construction, the sample average of $risk$ is zero, so that the periods of positive and negative values of $risk$ can be treated as periods of higher and lower levels of risk than the average level, or lower and higher levels of attractiveness of this market. The period of highest risk preceded the August 1998 Russian financial crisis. Of a relatively high risk are two episodes around the beginnings of years 1996 and 1997, which may be associated with political uncertainty related to presidential elections in June 1996, as well as the 2001, somewhat the end of 2002 and the beginning of 2003, which may be explained by uncertainty of Putin's intentions at the beginning of his presidency. In contrast, there is relatively high attractiveness in 1995 when the Russian stock market was just starting out, during the Asian financial crisis in the second half of 1997, during a relatively long period after the Russian financial crisis, and in 2004 after the market had been rocked by the Yukos case.

We run rolling regressions with a moving window of 52 observations corresponding to one year. We do this for two data spans. The first period covers ten years from January 1995 to January 2005. The second period covers a bit more than five years from October 1999 to January 2005. More local-factor data is available for the latter period. For this shorter period, we also supplement the set of regressors by volatility variables. We use conventional (non-robust) standard errors, despite slight serial correlation in the residuals (as evidenced by small departures of the Durbin–Watson statistics from 2) because it is documented that their simplicity may actually hold an advantage over robust standard errors in small samples (Mishkin, 1990). Of course, we do not take the standard errors at face value as the actual level of testing for significance of coefficients under sequential testing differs from that under one-shot testing. Still, the standard error bands are informative; for example, they may be used as indicators of estimation uncertainty.

For the longer time interval, the dependent variable is $\Delta \ln(msci^{ru})$, the independent variables, apart from a constant, are local instruments $\Delta \ln(er_{-1})$ and $risk_{-1}$, and global factors $\Delta \ln(oil)$, $\Delta \ln(msci^{us})$, and $\Delta tbill$. The exchange rate and risk are lagged (one week) to avoid the simultaneity effect, while global factors are taken with a lag of one day, since the US markets operate when Russia's domestic markets are already closed. Otherwise, global factors are presumed exogenous. The evolution of regression coefficients together with 5% (pointwise) confidence bands are presented in Figure 3, and the evolution of the regression R^2 is depicted in Figure 4.

The top left panel in Figure 3 shows the evolution of influence of growth in oil prices. This influence was found significantly positive in Hayo and Kutan (2005). The explanation is simple: increases in oil prices raise revenues and hence investment, both into the capitalization of oil companies and the stock market. Most of the time this effect is found to be positive. The exceptions are the "puberty" period of 1995 and the period preceding 1998 crisis, when the market operated in a speculative mood. When positive, the elasticity is rather small despite the large share of oil extracting companies – possibly because oil export earnings were moved to affiliated companies for the purpose of tax minimization in a greater degree than they were invested. Interestingly, the confidence band tends to shrink as time passes. making it easier to pin down this influence. The top right panel in Figure 3 shows the evolution of influence of exchange rate depreciation. There is a distinct period of relatively large negative influence before the window takes on observations after the Central Bank of Russia (CBR) has announced it will pursue gradual devaluation of the ruble. Once the window includes the crisis observations, the influence of exchange rate depreciation goes completely flat (with a slight non-zero influence after 1999).

An interesting pattern unfolds in the two middle panels that present the evolution of influence of indicators from two US financial markets – stock and credit. The positive and significant influence of the US stock market is apparent and confirms previous findings on the integration of Russian and US stock markets (e.g., Jithendranathan and Kravchenko, 2002; Hayo and Kutan, 2005). The degree of integration, however, is not constant. There is a remarkable downward trend extending from 2000 to 2003. This trend only recently changed to a strong positive trend, taking the degree of integration to its typical level of 1996–2000. At the same time, dependence on US interest rates is less pronounced, varying from negative to positive and back throughout the entire period. Recently, however, it has taken on large and significant negative values.

Finally, the evolution of influence of risk/attractiveness factors is depicted in the bottom panel. This influence turns out to be strong, negative, and very volatile throughout, except for the pre-crisis and crisis periods when is was non-trivially positive, presumably because of a highly speculative mood in the market during turbulent times.

In Figure 4, the evolution of the regression R^2 is depicted. The explanatory power of the regression varies considerably, from a few percent in 1996 and 2003 to nearly 50% in 1997, 2000–2001, and 2004. The initial noisy behavior of the Russian stock market in 1996 can be explained by uncertainty over the outcome of the presidential elections. Regression R^2 has much less explanation power during the 2000 presidential elections as the outcome was much more predictable. The most stable periods of the Russian economy (1997, 2001–2002, and 2004), are marked with a very high predictability of returns. Market preformance in 2004 also reflects increased dependence on world financial markets.

The high variability of the estimated coefficients clearly suggests instability. An important conclusion from this is that regressions on long time intervals may lead to spurious findings of causality for some factors, and conversely, to seeming insignificance of factors that were sources of significant influence during some periods. This may be a reason, in addition to the omitted variables bias, that e.g. Hayo and Kutan (2005) did not find their news variables significant. To illustrate, we run a one-shot regression using the data from the whole sample. This regression yields the following results:

$$\begin{aligned}\Delta\widehat{\ln(msci^{ru})} &= \underset{(0.0035)}{0.0016} + \underset{(0.0632)}{0.0773}\Delta\ln(oil) - \underset{(0.065)}{0.108}\Delta\ln(er_{-1}) - \underset{(0.0170)}{0.0139}\, risk_{-1} \\ &\quad + \underset{(0.140)}{0.896}\Delta\ln(msci^{us}) - \underset{(0.0384)}{0.0230}\,\Delta tbill,\end{aligned}$$

with $R^2 = 8\%$. The overall regression R^2 conceals much higher predictability during certain periods. As far as the coefficient significance is concerned, only $\ln(msci^{us})$ turns out to be significant at the 5% level. The robustness analysis in Hayo and Kutan (2005), surprisingly, does not though lead to conclusions about structural instability.

For the shorter time interval, we add several instruments. The additional local instruments are vol^{er}_{-1}, $\Delta mibor_{-1}$, $\Delta\ln(gold_{-1})$ and $\Delta\ln(money_{-1})$, and the additional global factors are vol^{oil} and vol^{us}. The evolution of regression coefficients together with 5% (pointwise) confidence bands are presented in Figure 5, and the evolution of the regression R^2 is depicted in Figure 6.

The upper two panels of Figure 5 suggest the role of energy prices in forming stock prices decreased. During the last couple years, the influence of oil prices switched from positive to negative. If one takes this negative impact at face value, it may be explained by the growing perception that excessive dependence on oil exports and high oil prices reduces the future prospects of the real sector, and thereby pushes stock prices down. The decreasing influence of the volatility of oil prices confirms the diminishing impact of the energy market. Hayo and Kutan (2005) also found insignificance of coefficients on various model-based indicators of oil price volatility in a one-shot regression.

The next pair of panels shows the evolution of the influences of exchange rate depreciation and exchange rate volatility. The sign of the impact of exchange rate changes varies from negative to positive, as does the sign of the impact of the exchange rate volatility. There is, however, a tendency toward insignificance of both factors, especially recently, as well as toward less uncertainty in pinning down the estimates.

The third pair of panels pictures the evolution of the impact of the US stock market. The left panel shows that, after years of decline, this impact reached zero around 2003 and then began to increase. Recently, it climbed to near its historical maximum, with the elasticity exceeding unity. US stock return volatility positively influences Russian stock prices most of the time, and this influence has also increased during recent years. The big positive impact of US stock returns and their volatility indicates that foreign investors are more willing to invest in the Russian stock market, especially when alternative markets are more volatile.

The fourth pair of panels tracks the influence of US and Russian short-term interest rates. It is clear that the influence of neither encompasses the influence of the other: sometimes only one has an effect, sometimes both, sometimes neither. The influence is largely negative and consistent with evidence in developed stock markets (e.g., Rapach and Wohar, 2004), except for few episodes where they were positive. Recent years have witnessed a sharp rise in the degree of influence of both international and domestic credit markets.

The fifth pair of panels shows how the money market in Russia influences the stock market, specifically the CBR's gold reserves and credit balances, i.e. money that domestic banks keep at correspondent accounts with the CBR that could otherwise be invested in the stock market. Both variables exerted both positive and negative influences on the stock market until mid-2002. Thereafter, the influence of both variables has been essentially zero.

Finally, the influence of risk factors depicted in the bottom panel is negative (although quite variable) throughout the last five years. The evolution of the regression R^2 shown on Figure 6 is also quite variable, and recently reached nearly 60%.

From the above analysis, one can infer slow progress toward the integration of the Russian and international stock markets: domestic factors playing a gradually diminishing role, while the importance of international factors has been increasing. In the next section we explicitly consider measures of integration and verify this conjecture.

4 Integration with other markets

In this section, we systematically analyze the integration between Russian stock returns and international equity markets, both regional and sectoral. Regional markets include the developed markets of the US, the World (except the US), Europe, the Pacific region, as well as emerging markets in Latin America and Asia (Table 1 contains detailed information on the composition of MSCI regional indexes). The sectoral markets considered are the energy market, the market for materials, the market for capital goods, and the IT and telecommunications industries (Table 2 contains detailed information). The data span the period January 2, 1995 to December 30, 2004.

The degree of integration is usually judged by co-movements in stock prices or returns. A variety of methods have been applied in the literature, including regression-based analysis (e.g. Gelos and Sahay, 2001; Jithendranathan and Kravchenko, 2002), factor models (e.g. Dungey, Fry, González-Hermosillo, and Martin, 2003), and cointegration analysis (e.g. Lucey and Voronkova, 2004). We construct a *model-free* yearly measure of correlation of returns from the daily data in the way reminiscent of constructing "realized volatility" daily measures from intraday 5-minute returns (see e.g. Andersen, Bollerslev, Diebold, and Labys, 2003), and track its evolution during the decade.

More precisely, we consider daily returns from two markets, 1 and 2, denoted $r_t^{(1)}$ and $r_t^{(2)}$, where t is a number of the day, $t = 1, ..., T$. Suppose there are K (working) days within a year, D days within a week (excluding Saturdays and Sundays), and there are G years in total (which may not be integer), so that $T = GK$. In our case, $K = 260$, $G = 10$, and $D = 5$. The measure of "realized correlation" for year $g \in [1, G]$ (which may not be integer) is computed as

$$RC_g^{(1,2)} = \frac{\overline{\left(r_t^{(1)} - \overline{r_t^{(1)}}\right)\left(r_t^{(2)} - \overline{r_t^{(2)}}\right)}}{\sqrt{\overline{\left(r_t^{(1)} - \overline{r_t^{(1)}}\right)^2} \cdot \overline{\left(r_t^{(2)} - \overline{r_t^{(2)}}\right)^2}}},$$

where the bar denotes averaging over t running from $(g-1)K + 1$ to gK. We compute such measure over the running window with a step of one week (i.e. with $g = 1 + D/K$, $1 + 2D/K$, $1 + 3D/K$, $\cdots$, 2, $2 + D/K$, $\cdots$, G).

Figure 6 presents the patterns of evolution of realized correlations between Russian stock returns and those from developed markets: US (two top panels), World excluding the US (the left middle panel), Europe (the right middle panel), and Pacific region (two bottom panels). Note that we have drawn two graphs for the US and Pacific. We lag one of the returns by *one day* (US returns in the first case and Russian returns in the second). This is motivated by a time zone differences between the trading floors. The Russian exchanges, mostly located in Moscow, are open when the US floors are closed and closed when the floors in the Pacific are open. By comparing the two graphs, we infer which of two correlations prevailed, as well as which market was leader and which the follower in return variability.

From the two top panels in Figure 7, one can see that, apart from the period of initial development of the Russian stock market through the 1998 crisis and its aftermath widely documented in previous studies (e.g. Gelos and Sahay, 2001), the degree of integration of the Russian and US stock markets on average did not have a positive trend – a finding that contradicts e.g. Jithendranathan and Kravchenko (2002). Instead, the degree of integration varied between 0.05 and a little over 0.3. At the same time, while the measures of correlatedness without a lag and with a lag exhibited similar evolution up to 2002–2003, they have recently been moving in opposite directions. During 2003–2004, the Russian stock market apparently was causing less return volatility in the US stock market, while the US stock market was causing greater return volatility in the Russian stock market. The middle two panels indicate that the integration of the Russian stock market with the developed world other that US, and Europe in particular, is larger than that with the US market. From the similarity of the two graphs, we also conclude that the European stock market has been a leader in the integration with the Russian market among developed stock markets, presumably because of greater trade links between Russia and Europe. The realized correlations during the Asian and Russian financial crisis are particularly large. The co-movement between the Russian and Pacific markets is less pronounced as can be seen from the two bottom graphs. In this co-movement, the Pacific market seems to be more of a leader, and the Russian market seems more of a follower. Similarly to the situation with the US market, the Russian stock market during 2003–2004 was decreasingly affecting return volatility in the Pacific stock market, while the Pacific stock market was increasingly causing return volatility in the Russian stock market. The ranking in the degree of correlatedness with largest regional markets (highest with the European markets, lowest with Asian markets, and in the middle with the American markets) is an average supported by conclusions in other studies of contagion analysis (see e.g. Dungey, Fry, González-Hermosillo, and Martin, 2003).

We now turn to patterns of integration of the Russian and the Asian and Latin American

(LA) emerging markets depicted in Figure 8. It is immediately apparent that correlatedness shoots up during the Asian crisis, with the spillovers mostly leaking from the Asian and LA markets to the Russian market. The high spike in spillovers leaking from Russia to LA during 1997 reflects those coming from Asian markets to the Russian market and propagating further. Interestingly, the correlatedness between the Russian and LA returns, with the LA market acting as a leader, was *negative* during the Asian and Russian crisis periods. On the other hand, no additional contagion effects during the period of January–March 1999 Brazilian crisis seem evident. In the left upper panel, additional strong spillovers from the Asian to the Russian market are found during 2000–2001.

As is typical, it is hard to identify the channels through which shocks between the Russian and other stock markets are transmitted. It is unlikely that the global shocks are dominant, as the sharp drop in world interest rates and stock prices in 2001 did not seem to alter the pattern of return co-movements between Russian and emerging regional stock markets. As far as the developed markets are concerned, such abrupt changes resulted in only inappreciable falls in degrees of integration. The main channel of transmission is not likely to be international trade either, as there is a clear upward trend in Russia's trade volume, at least from the beginning of 1999. Hernández and Valdés (2001) claim that financial competition was the only relevant channel during the Russian crisis, and Medvedev (2001) finds that a dominant role in capital outflows from Russian financial markets during crises is played by non-resident investors. Apparently, the main reason for the high co-movements is financial linkages including direct trading by non-residents in the Russian stock market, although one cannot exclude mimicking behavior on the part of market participants (Masson, 1999).

Figure 9 portrays the dynamics of realized correlations between Russian stock market returns and returns from each of the five world sectoral markets (note that these world indexes do not count Russian securities). Apart from the high variability of correlations, this evidence seems rather surprising. The panel representing the IT sector, which is barely represented in the Russian index, suggests correlation as high as 0.4. Presumably, these figures may be taken as a relative variance of the "common factor" in the Russian and world stock returns. It is also worth noting that the presence of this "common factor" diminished during the last three years.

Four other sectors are represented in the Russian index, with the energy sector dominant. Interestingly, the energy correlations seem quite similar to the three others. Indeed, during the 1998 pre-crisis and crisis periods, the energy correlation was around 0.3, matching the IT correlation, while the materials, capital goods and telecom correlations reached nearly 0.5. Hence, the crisis-related spillover effects may be grasped in a larger degree by sectors other than the sector dominating the market emitting these spillovers. The ups and downs in the correlations in Figure 9 after the Russian crisis do not necessarily tend to be accordant. In fact, the correlation between these figures during 2000–2004 vary from -0.45 (between energy and telecom correlations) to 0.93 (between capital goods and IT correlations).

Even though most influential Russian stocks represent the energy extraction sector, the evidence here and in previous chapters is at variance with a common perception that the oil price must be a dominating factor in stock price formation. This is also confirmed by the figures of correlatedness of Russian stock returns and the oil price growth directly. It turns out that the spillovers from the oil market are much lower than those from international stock markets. The corresponding realized correlation typically lies between zero and 0.1, and only at the end of 2001 and beginning of 2002 it reaches the value 0.2.

5 Efficiency of Russian stock market

The existing literature documents a significant amount of predictability and (weak form) inefficiency in stock markets in post-communist countries, Russia in particular, at the end of 20th century (see Zalewska-Mitura and Hall, 1999; Rockinger and Urga, 2000). At the same time, one can observe a movement toward efficiency in some of these markets (Rockinger and Urga, 2000). In this section, we investigate by formal nonparametric methods if such movement indeed occured during that period and whether it continued into the new century.

We test the hypotheses that the weekly series of Russian stock returns has been mean non-predictable from the observable past during the decade under consideration. The excess profitability (EP) test of Anatolyev and Gerko (2005) allows one to test the property of conditional mean independence

$$E_{t-1}\left[r_t\right] = \text{const},$$

i.e. that the conditional mean of the series of returns r_t is impossible to predict using past information. Here, conditioning is on observable information available when investment decisions are made. Let $\hat{r}_t$ be a continuously distributed forecast of r_t using information at $t-1$. The one-shot EP test statistic has the following forms:

$$EP = \sqrt{\frac{T}{\hat{V}_{EP}}} \left(\frac{1}{T} \sum_t \text{sign}(\hat{r}_t) r_t - \left(\frac{1}{T} \sum_t \text{sign}(\hat{r}_t) \right) \left(\frac{1}{T} \sum_t r_t \right) \right),$$

where

$$\hat{V}_{EP} = \left(1 - \hat{m}_{\hat{r}}^2\right) \hat{V}_r - 2\hat{m}_{\hat{r}} \hat{C},$$

and

$$\begin{aligned} \hat{m}_r &= \frac{1}{T} \sum_t \text{sign}(r_t), \quad \hat{m}_{\hat{r}} = \frac{1}{T} \sum_t \text{sign}(\hat{r}_t), \\ \hat{V}_r &= \frac{1}{T} \sum_t (r_t - \bar{r})^2, \quad \hat{C} = \frac{1}{T} \sum_t \left(\text{sign}(\hat{r}_t) - \hat{m}_{\hat{r}}\right) r_t^2. \end{aligned}$$

Everywhere, summation goes from 1 to T. As $T \to \infty$, under the null of conditional mean independence $E_{t-1}[r_t] = \text{const}$, we have $EP \xrightarrow{d} \text{N}(0,1)$.

If the hypothesis $E_{t-1}[r_t] = \text{const}$ is violated and there are no transaction costs or other market limitations, it is possible to extract profits from judiciously investing in this market and the market is (weak form) inefficient. Below, we adapt the hypothesis and test by performing sequential testing a great number of times in a moving window and computing the revenues of a virtual investor using a simple trading strategy. The trading strategy at the heart of the EP test issues a buy signal when the forecast for next period return is positive (and a sell signal, otherwise):

$$\begin{cases} \text{buy shares worth current wealth,} & \text{if } \hat{r}_t \geq 0, \\ \text{sell shares worth current wealth,} & \text{otherwise.} \end{cases}$$

Thus, our virtual investor goes long when the prediction for the next period return is positive (and short, otherwise). Equipped with this trading strategy, the investor modifies her position each trading period closing it at the end of the period (see Gençay, 1998; Anatolyev and Gerko, 2005). Note that the EP statistic can be interpreted as a normalized return of the position implied by the trading strategy described above (for details, see Anatolyev and Gerko, 2005). We adapt the EP test to the retrospective situation (a brief description of the testing algorithm is contained in the Appendix). If the value of the EP statistic exceeds a critical value at least for one window position, the hypothesis of mean non-predictability during the entire trading period is rejected. If the hypothesis is rejected, the periods of inefficiency may be identified as those window positions when the EP values exceeded the critical value threshold.

There is a choice to be made for the predictor $\hat{r}_t$. Intuitively, the more powerful this predictor, the higher the profits that may be obtained using the trading mechanism, and thus the higher the predictive power of the EP test. As the linear parametric model of Section 3 showed great explanatory power, at least during some periods, we try various predictors obtained using the same regressors available for the full period, i.e. $\Delta\ln(oil_{-1})$, $\Delta\ln(er_{-1})$, $\Delta\ln(msci^{us}_{-1})$, $\Delta tbill_{-1}$, as well as lagged index growth (the variable $risk_{-1}$ is not included as it available from the ex post analysis). Note that the global variables here are taken with weekly lags, too, because the decision variables should be known at the time when the investment decisions are made. We choose that combination of regressors for which the cumulative return from the trading strategy at the end of the decade is highest. In this sense, it turns out that the "best" predictor is formed by regression on a constant, $\Delta\ln(oil_{-1})$, $\Delta\ln(msci^{us}_{-1})$, and $\Delta tbill_{-1}$. At each point the predictor is computed using regression coefficients estimated from the weekly data corresponding to a year before that point, and, of course, using only past data already available at that point. Hence, the virtual trading process starts one year after the beginning of the decade, i.e. in January 1996.

Figure 10 presents graphs of evolution of cumulative logarithmic returns of the buy-and-hold strategy (i.e. investing the entire wealth and closing the position in 2005), and the trading strategy described above. In monetary terms, the log-return from the buy-and-hold strategy equals 1.9432, corresponding to the return of 698% over nine years. The log-return from the trading strategy equals 2.7674, corresponding to the return of 1,592% over nine years. The positive return is predicted 303 times, while the negative return is predicted 171 times. The ideal profit measure, i.e. the cumulative log-return of the trading strategy over that of the perfect foresight predictor (Gençay, 1998) equals approximately 10% at the end, and reaches a maximum of 38% in mid-1997. It is clear from Figure 9 that, up to early 1998, the forecasts are so poor that even costless trading would have resulted in a return equal or lower than a buy-and-hold approach. However, just before and during the 1998 Russian financial crisis, it was pretty easy to forecast negative drops and achieve high returns by applying the trading mechanism. This changed in the early 1999 when losses from trading had offset a large portion of the gains obtained. Some of these losses were compensated by appreciable gains at the end of 2000, but starting from that point, the trading process on average brings losses. The virtual investor would have done better to withdrawn her funds and close the position at that point, although she also ends the period with a positive surplus over the investor using a buy-and-hold strategy.

Of course, the described trading is merely a thought experiment. In practice, one would not be able to implement it for a number of reasons, including restrictions on short selling in the Russian market, significant transaction costs, and the lack of an MSCI index investment product. Yet, even in a costless and frictionless trading environment, a virtual investor would not be particularly successful in extracting large profits. This is confirmed by the evolution of the EP statistic depicted in Figure 11. For no position of a rolling window did the EP statistic exceeded even the one-sided 5% critical value (shown by the dotted line). Although there are numerous ups and downs in the value of the EP statistic, its path is consistent with the behavior of increments of Brownian motion. In conclusion, we can augment the findings of Rockinger and Urga (2000) with a finding that the efficiency in the Russian stock market, once established, has persisted throughout the beginning of the new century.

6 Conclusion

The results reported in this paper provide overwhelming evidence of structural instability in the Russian stock market and that the instability was not confined to financial crises. In recent years, the influence of oil prices and foreign exchange rates on Russian stock returns has diminished, while the influence of US stock prices and US and Russian interest rates has increased. The influence of monetary aggregates such as gold reserves and credit balances, once non-trivial, has recently fallen to practically zero. In total, the explanatory power of available domestic and global factors has fluctuated appreciably, with the value of regression R^2 swinging from just a few percent in 2003 to as much as 60% in 2004. There has been no clear positive trend in the degree of integration of the Russian stock market with other stock markets, both regional and sectoral. However, spillovers from other stock markets into the Russian market have increased in recent years, while spillovers in the opposite direction have diminished. There is evidence that the integration with developed European markets is higher than that with US and Asian markets. The co-movements of Russian and world sectoral stock markets exhibit a varying pattern. They are high much of the time, but not necessarily greater for energy markets, despite the domination of the Russian market by oil and gas extraction companies. The weak-form market efficiency of the Russian stock market was confirmed, and a judicious trading strategy of a virtual investor based on publicly observable information was not particularly profitable compared to a buy-and-hold strategy – even under the assumption of no transaction costs and despite good profit opportunities in 1998 and 1999.

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A Appendix: Retrospective version of the EP test

Suppose that the same hypothesis is tested $[(1-h)T]$ times in a moving window of width $[hT]$, where $0 < h < 1$ is fixed. Denote the values of the EP test computed using data from $t - [hT] + 1$ to t by EP_t, with t taking values $[hT]$, $[hT] + 1, \cdots, T$. Then under suitable conditions, as $T \to \infty$,

$$\sqrt{h} \max_{t=[hT],\cdots,T} EP_t \xrightarrow{d} \sup_{h \leq r \leq 1} \left(W(r) - W(r-h)\right).$$

Here, $W(r)$ is a univariate standard Wiener process. These results lead to the following decision rule: the asymptotic size α one-sided test is

$$\text{Reject if } \sqrt{h} \max_{t=[hT],\cdots,T} EP_t \geq q_\alpha,$$

where q_α is a critical value, depending on h, corresponding to significance level α. In our situation, $h = \frac{1}{9}$ (one year inside the window divided by nine years of retrospection). The critical values that can be obtained by simulations are the following:

10%	5%	1%
1.00	1.08	1.25

Index name	Description	Coverage
MSCI World ex USA	Free float-adjusted market capitalization index designed to measure global developed market equity performance, excluding USA	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, UK
MSCI Europe	Free float-adjusted market capitalization index designed to measure developed market equity performance in Europe	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK
MSCI Pacific	Free float-adjusted market capitalization index designed to measure equity market performance in the Pacific region	Australia, Hong Kong, Japan, New Zealand, Singapore
MSCI EM Asia	Free float-adjusted market capitalization index designed to measure emerging equity market performance in Asia	China, India, Indonesia, Corea, Malaysia, Pakistan, Philippines, Taiwan, Thailand
MSCI EM Latin America	Free float-adjusted market capitalization index designed to measure equity market performance in Latin America	Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela

Table 1. Definitions and composition of MSCI regional indexes.

Index name	Description	Industries
MSCI World Energy	Capitalization weighted index that monitors the performance of energy stocks	Energy equipment & services, oil & gas
MSCI World Materials	Capitalization weighted index that monitors the performance of materials stocks	Chemicals, construction materials, containers & packaging, metals & mining, paper & forest products
MSCI World Capital Goods	Capitalization weighted index that monitors the performance of capital goods stocks	Aerospace & defense, building products, construction & engineering, electrical equipment, industrial conglomerates, machinery, trading companies & distributors
MSCI World Information & Technology	Capitalization weighted index that monitors the performance of IT stocks	Internet software & services, IT services, software, computers & peripherals, electronic equipment & instruments, office electronics, semiconductors & semiconductor equipment
MSCI World Telecommunication Services	Capitalization weighted index that monitors the performance of telecom stocks	Diversified telecommunication services, wireless telecommunication services

Table 2. Definitions and composition of MSCI sectoral indexes.

Figure 1.

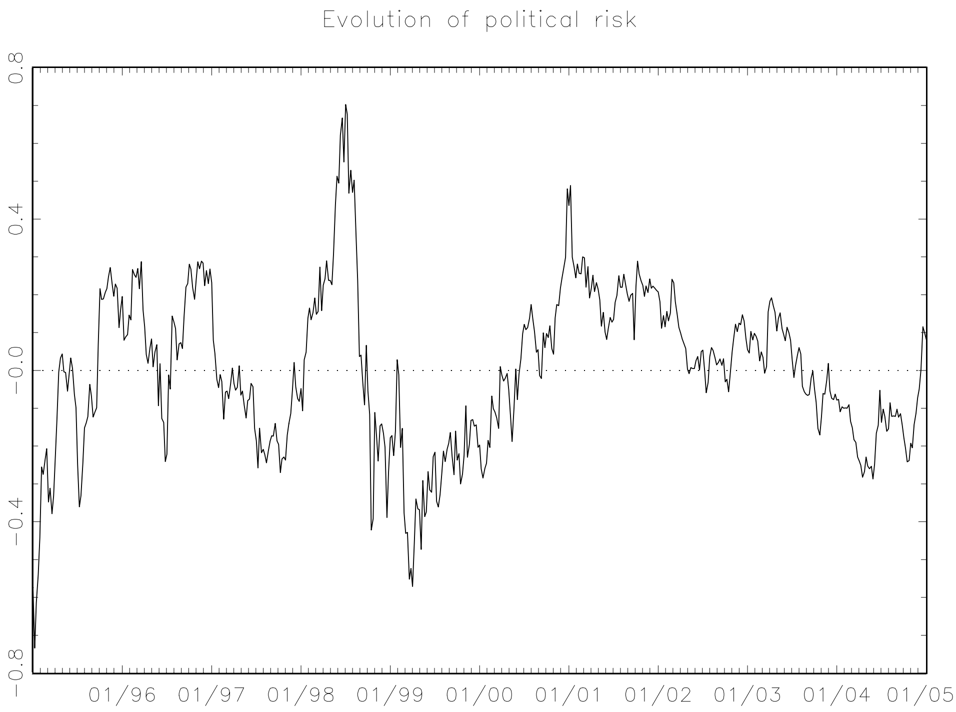

Figure 2.


Influence of Oil Prices
1.2
0.0
−1.2
95 96 97 98 99 00 01 02 03 04
Influence of Exchange Rate
50
25
0
−25
−50
95 96 97 98 99 00 01 02 03 04
Influence of US Stock Prices
4
3
2
1
0
−1
−2
95 96 97 98 99 00 01 02 03 04
Influence of US Interest Rates
1
0
−1
95 96 97 98 99 00 01 02 03 04
Influence of Political Risk
0.4
0.2
−0.0
−0.2
−0.4
−0.6
95 96 97 98 99 00 01 02 03 04

Figure 3.


Evolution of regression R^2
60
50
40
30
20
10
0
95
96
97
98
99
00
01
02
03
04

Figure 4.


Influence of Oil Prices
0.8
0.0
−0.8
00
01
02
03
04
Influence of Volatility of Oil Prices
1
0
−1
Influence of Exchange Rate
20
10
0
−10
−20
Influence of Volatility of Exchange Rate
Influence of US Stock Prices
3
2
1
0
−1
Influence of Volatility of US Stock Prices
2
1
0
−1
−2

Figure 5.

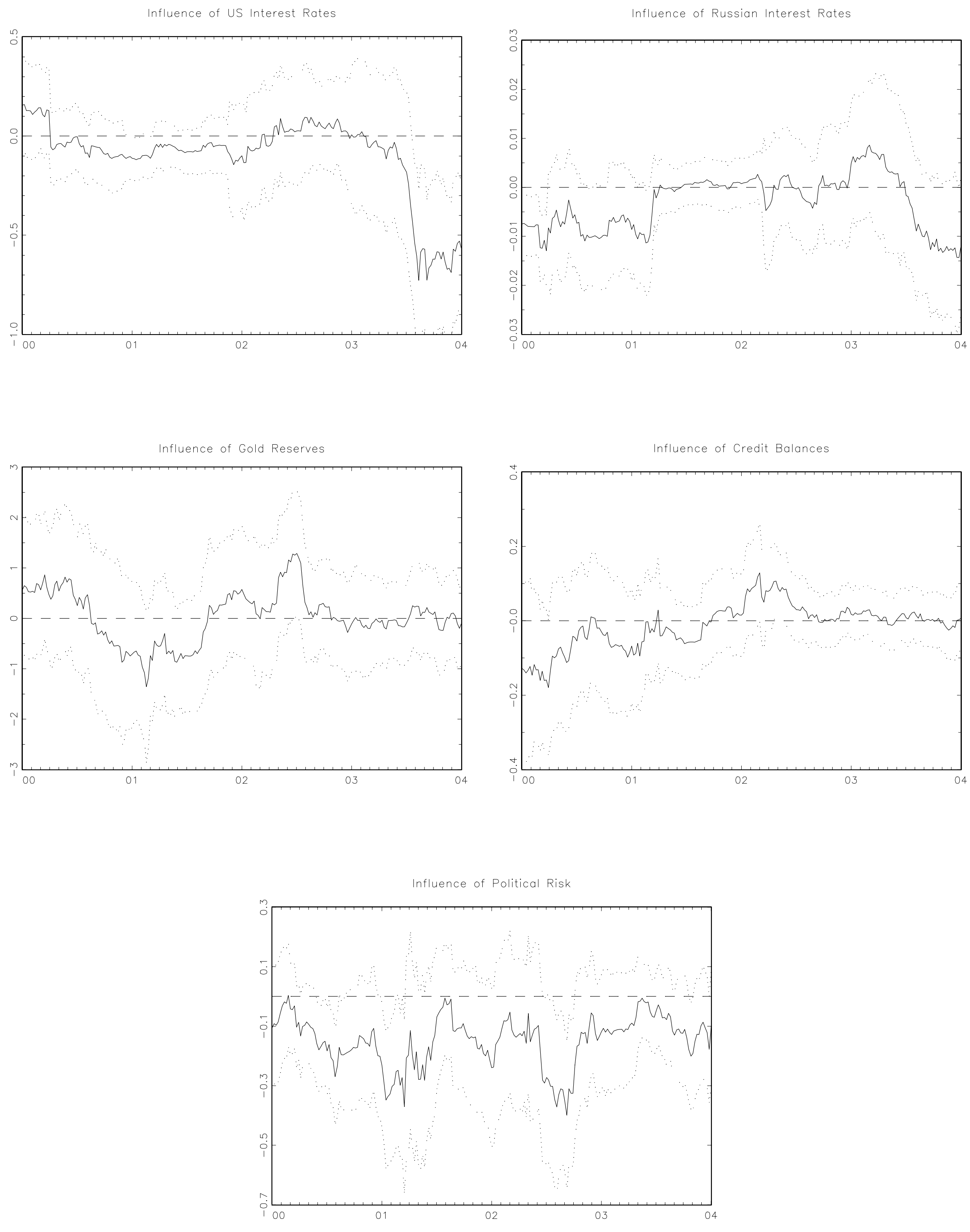

Figure 5 continued.

Figure 6.

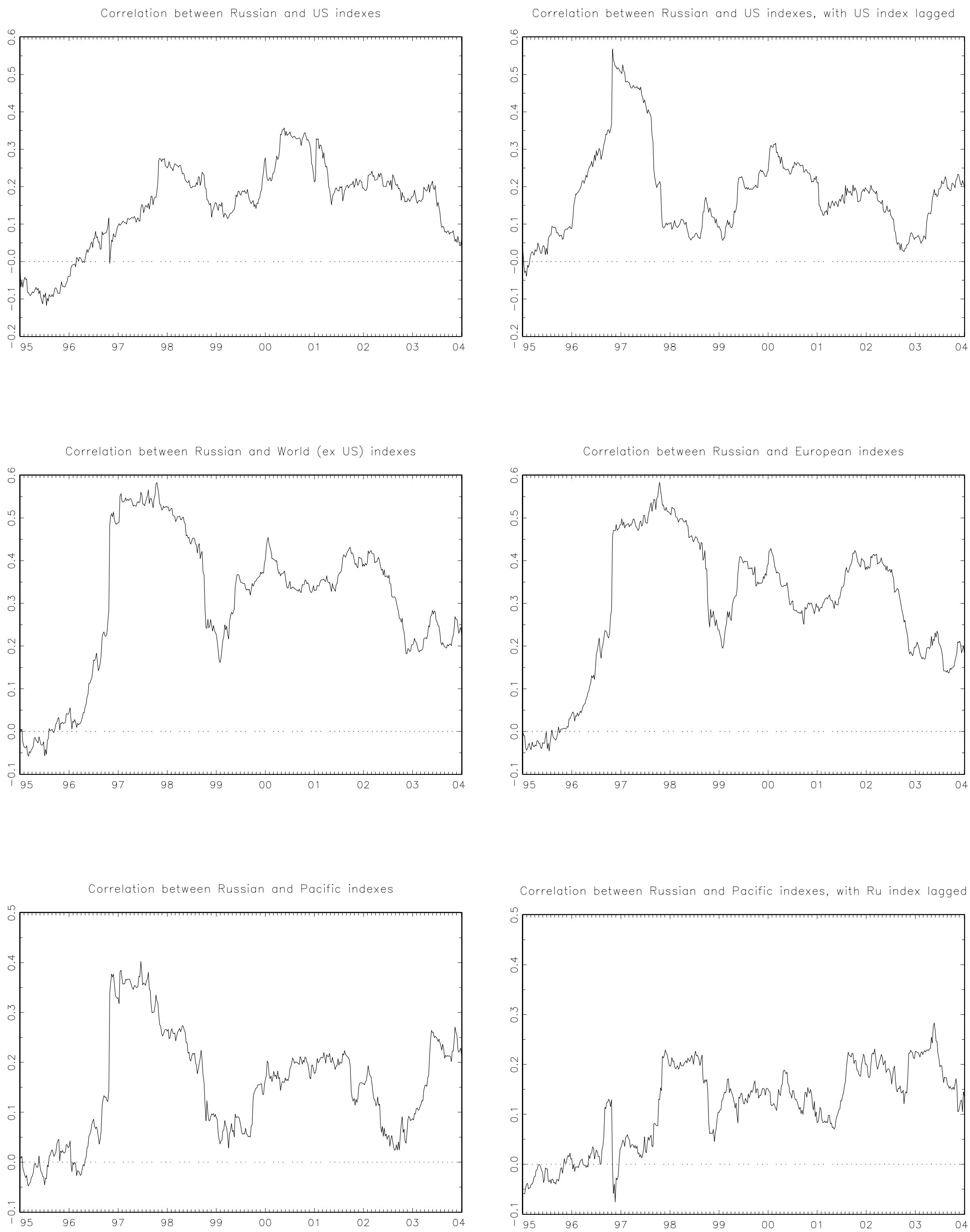
Correlation between Russian and US indexes
Correlation between Russian and US indexes, with US index lagged
Correlation between Russian and World (ex US) indexes
Correlation between Russian and European indexes
Correlation between Russian and Pacific indexes
Correlation between Russian and Pacific indexes, with Ru index lagged
95 96 97 98 99 00 01 02 03 04

Figure 7.

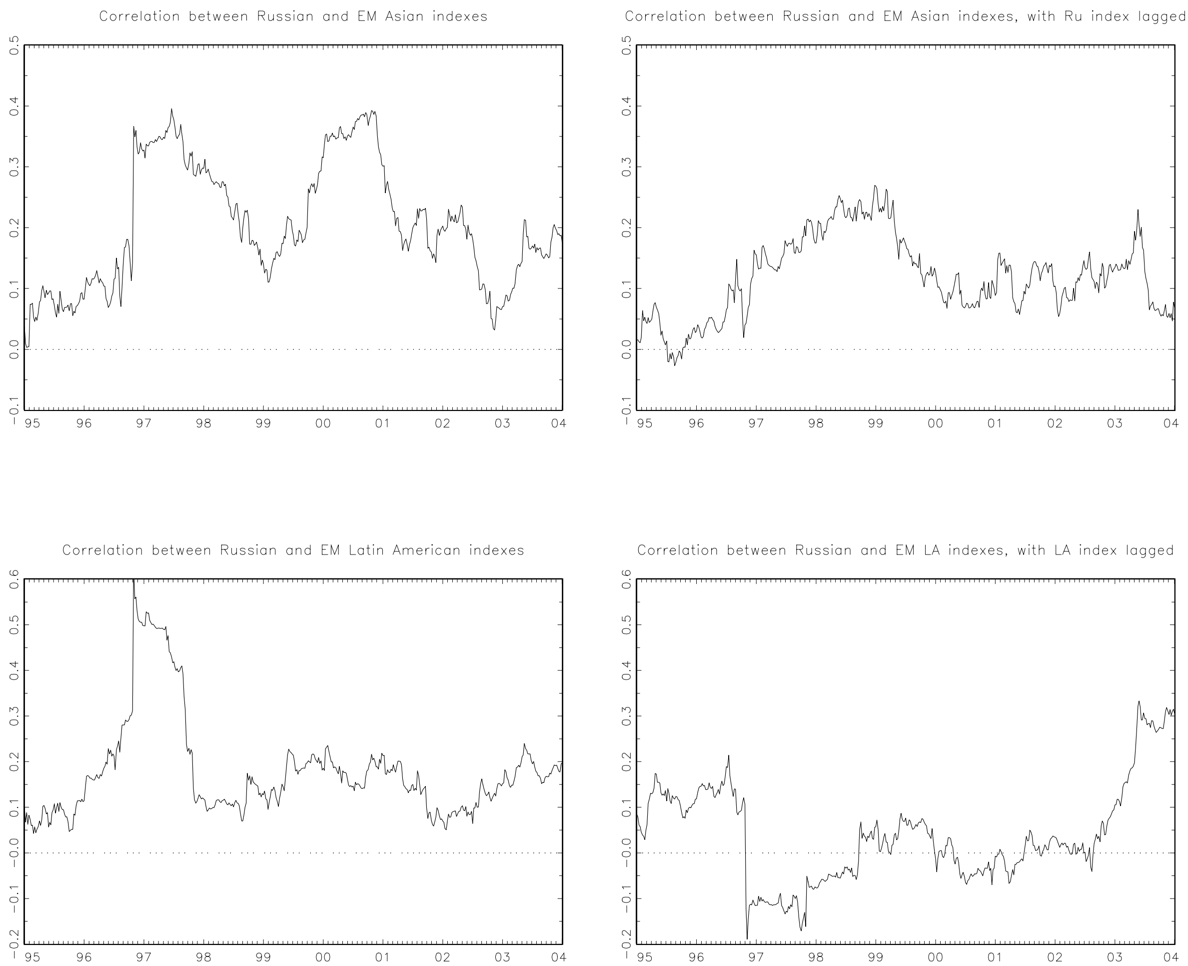
Correlation between Russian and EM Asian indexes
Correlation between Russian and EM Asian indexes, with Ru index lagged
Correlation between Russian and EM Latin American indexes
Correlation between Russian and EM LA indexes, with LA index lagged
95 96 97 98 99 00 01 02 03 04

Figure 8.

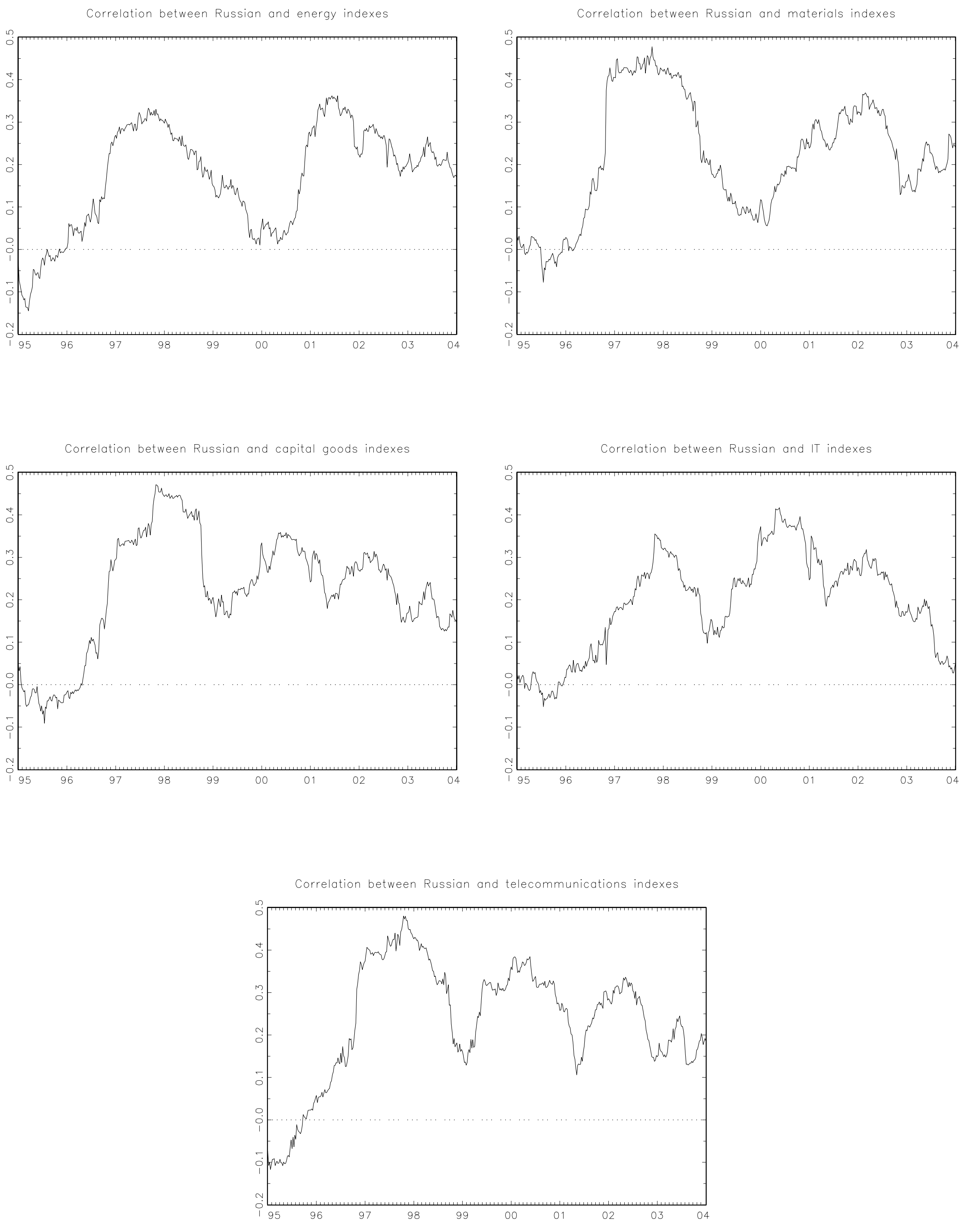
Correlation between Russian and energy indexes
Correlation between Russian and materials indexes
Correlation between Russian and capital goods indexes
Correlation between Russian and IT indexes
Correlation between Russian and telecommunications indexes
−0.2 −0.1 −0.0 0.1 0.2 0.3 0.4 0.5
95 96 97 98 99 00 01 02 03 04

Figure 9.

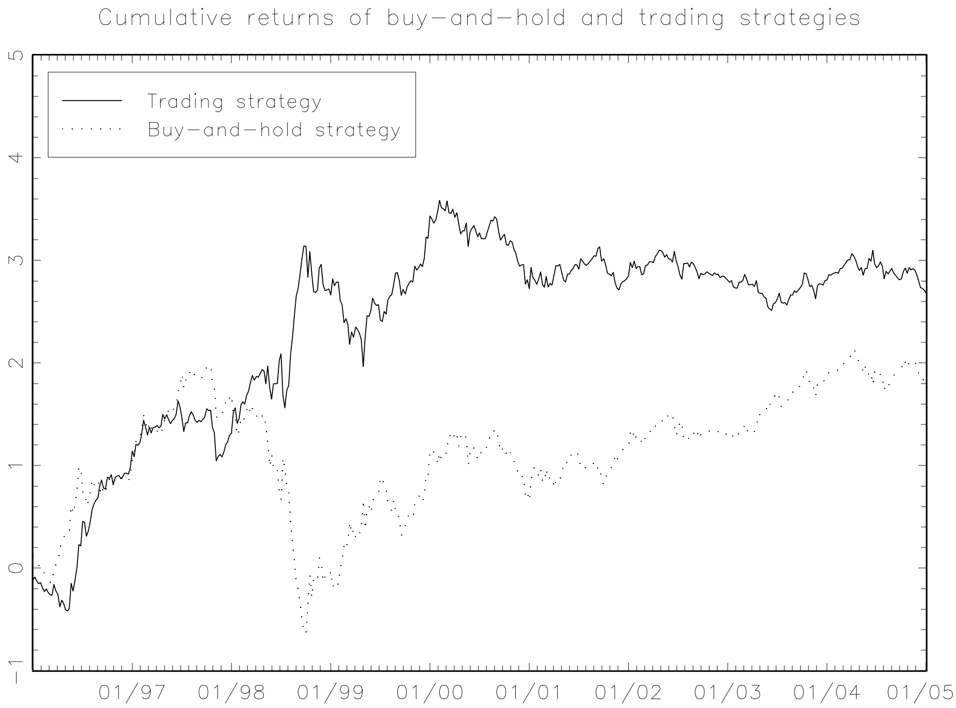

Figure 10.

Figure 11.

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