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# **Вестник исследований бизнеса и ЭКОНОМИКИ**

*№ 3, 2015*

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# An Empirical Analysis of the Russian Financial Markets' Liquidity and Returns\*

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**Abstract.** The study aims to identify whether illiquidity and returns in the Russian stock and bond markets may be forecasted with the help of local macroeconomic variables, internet queries, global factors as well as the fundamental asset classes' characteristics. To address these questions we use the correlation analysis, the VAR analysis and Granger causality tests. Despite the structural instability of the Russian financial markets, the market microstructure variables influence each other and are affected by the characteristics of other asset types. In highly volatile markets dynamic models should be applied. Stock and bond returns may be used for forecasting liquidity and volatility in the Russian market. Stock illiquidity is not useful for forecasting returns in the Russian market as opposed to the US and UK markets. In the Russian market investors rely on risk factors rather than on illiquidity measures in decision-making process. Bond maturity in the Russian market has a significant impact on the bonds' characteristics and implicitly on switching between different asset classes similarly to the US market. Increase in the number of internet queries may serve as an indicator of higher volatility and illiquidity in the Russian stock market in the future, but Google Trends should be used only in combination with other forecasting tools such as macroeconomic measures and political situation analysis.

**Аннотация.** Целью работы является исследование возможностей прогнозирования неликвидности и доходности на российских рынках акций и облигаций с помощью макроэкономических переменных, данных по запросам в сети Интернет, глобальных факторов, а также фундаментальных характеристик различных классов активов. Для изучения данного вопроса используются корреляционный анализ, система векторных авторегрессий и тест причинности Грейнджера. Несмотря на структурную нестабильность российских финансовых рынков, переменные микроструктуры рынка влияют друг на друга и подвержены влиянию характеристик других классов активов. Для анализа рынков с высокой степенью волатильности необходимо использовать динамические модели. Доходность акций и облигаций может быть использована для прогнозирования ликвидности и волатильности на российском рынке. В отличие от рынков США и Великобритании фактор неликвидности акций не эффективен для прогнозирования доходности на российском рынке. В процессе принятия решений инвесторы на российском рынке в большей степени руководствуются факторами риска, чем показателями индикаторов неликвидности. Срок погашения облигаций на российском рынке имеет значительное влияние на характеристики облигаций и косвенно на переключение инвесторов между классами активов, что соответствует ситуации на рынке США. Увеличение количества интернет-запросов по российскому фондовому рынку может служить индикатором повышения волатильности и неликвидности в будущем, но Google Trends может быть использован только в комбинации с другими инструментами прогнозирования, такими как макроэкономические индикаторы и анализ политической ситуации.

**Key words:** Russia, financial market microstructure, Google Trends as a forecasting tool, illiquidity spillovers, macroeconomic indicators, dynamic modeling.

## INTRODUCTION

Every time a crisis happens, analysts address the questions of market efficiency, asset pricing or corporate finance. In the recent years liquidity has

gained an enormous importance in each of these areas. In times of globalization and well-developed electronic trading platforms investors may quickly transfer their funds between different jurisdictions, and negative political or economic news may have

\* Эмпирический анализ ликвидности и доходности российского фондового рынка.

a significant impact on stock and bond markets' liquidity and returns.

This study focuses on returns, liquidity that is calculated with the help of quotes and volumes as well as on the trading behavior. As such the research may be attributed to the field of market microstructure that focuses on the process and outcomes of trading assets under certain rules. Many economic studies describe the mechanics of trading, whereas microstructure theory explains how specific trading mechanisms influence the price formation process (O'Hara, 1995). In other words, the research in the given area examines factors influencing transaction costs, prices, quotes, volume, trading behavior, insider trading and market manipulation.

Financial crises of the last two decades have demonstrated that in unfavorable economic conditions liquidity may decrease significantly or even completely disappear. This fact may serve as an explanation of how liquidity shocks affect asset prices. There is a discussion in the contemporary literature on the causes of liquidity shortages and its contribution to financial crises. Brunnermeier (2008), Brunnermeier and Pedersen (2009) explain the concept of "liquidity spiral" that is a consequence of mutual reinforcing of market liquidity and funding liquidity that occurred during subprime mortgage crisis in the USA, and after that took place in many countries all over the world. The process of liquidity spiral starts when asset prices drop, which deteriorates financial institutions' capital. This results in tightening lending standards and margins. Both effects cause fire — sales and additional wave of price decreases. Adrian and Shin (2009) state that in the market-based financial systems the banking sector and capital markets are interconnected, and a contraction of broker-dealer balance sheets may be an indicator of a negative trend in economic growth. The description of the mechanism of liquidity shocks' influence on asset prices is presented in the studies of Amihud and Mendelson (1986) and Jacoby, Fowler and Gottesman (2000). Pastor and Stambaugh (2003) demonstrate that expected stock returns are linked to liquidity. Jones (2001) and Amihud (2002) state that liquidity is useful for expected returns prediction, however in their research liquidity is viewed in the context of transaction costs. Additional market microstructure elements examined in our research are return and volatility. Volatility or risk of the asset, typically measured as a standard deviation of returns is one of the factors that influence the willingness of investor to transfer funds between asset classes or assets. Returns are calculated on the basis of asset prices, either as differences or differenced logged prices.

Technological development has a growing influence on the society's everyday life. People rely on the online information sources not only in such life aspects as health and entertainment, but also in the personal finance area. Internet search tools help investors get information for free and in a timely manner. This information is likely to affect traders' decision making. According to MICEX (2015), individuals account for 53 per cent of all investors in the total shares trading turnover on the exchange. The above-mentioned dominance of individual investors in Russia to some extent supports the usefulness of internet searches for investment decision-making. The rationale behind the internet search influence on the financial markets' liquidity is based on the fact that investors have limited cognitive resources, because of the information tracking and processing costs (Grossman & Stiglitz, 1980; Merton, 1987). Due to these constraints market participants are likely to limit their choice to assets that attract their attention first. Information on the assets, which investors search in the internet, may serve as a proxy for macroeconomic announcements as well as company-specific or asset-specific news considered in the investment decision-making. Thus, it is probable that people tend to trade heavily relying on the news available online.

Efficient financial market concept has been introduced in Fama (1970) seminal paper and defined as "one in which prices fully reflect available information". Following Fama (1970) this issue has been addressed by dozens of scholars: Basu (1977), Rosenberg, Reid, and Lanstein (1985). This study explores the influence of publicly available online information on the fundamental characteristics of assets or asset classes. As such, it relies on weak-form market efficiency that assumes that "fundamental analysis may still provide excess returns". The Mixture of Distributions Hypothesis states that price volatility and trading volume are determined by the same information arrival rate (Luu & Martens, 2002). Renowned examples of MDH investigations are due to Clark, (1973), Epps and Epps (1976), Tauchen and Pitts (1983) and Andersen (1996). A common result of the Mixture of Distributions Hypothesis is that certain market activity patterns such as volatility persistence are determined by the same type of information flow (Vlastakis & Markellos, 2012).

One of the possible consequences of the economic news online availability for the international investment community decisions is an almost 250 percent net capital outflow increase which Russia experienced in 2014 as compared with 2013 (Bank of Russia, 2015). The Ministry of Economic Development of Russia (2015) forecasts that in 2015 investment is expected to fall by 13 percent. The initial forecast for the net capital outflow has been also increased by approximately

30 percent. Probable additional reasons for the investment outflow from Russia are economic slowdown and unfavorable environment of economic and political sanctions. At the moment the stock market experiences gradual recovery due to wider choice of investment contracts as well as market infrastructure improvement. Bond market suffered more from the sanctions, but the situation is likely to become better in the near future, because of the expansionary monetary policy of the Bank of Russia (*Vedomosti*, 2015). Dynamically changing patterns mentioned above as well as the unique character of the Russian market environment represent a particular interest for research.

The Russian market has been examined before with the focus and approach different from those in the given study. There are some similarities in the techniques employed, but no research exists, where particular models and tools are applied to the main research objects of the given master thesis with the same focus. It is necessary to mention that there are studies analyzing the relationship of stock and bond markets' microstructure parameters, research focusing on stock market parameters and Google Trends, but, to the best of our knowledge, there is no study that would have provided dynamic models for stock and bond market microstructure parameters with the participation of internet search query factors for the emerging market, and there is no research, where Granger causality test is performed on the recent data for the individual assets or asset classes characteristics, internet search parameters and macroeconomic variables for the Russian Federation. These models will be an innovation introduced in the given research. This study contributes to the literature by building and interpreting such models as well as by testing the effectiveness of modern forecasting tools that may be used by investment community in the future.

## 1. LITERATURE REVIEW

The studies of stock and bond markets illiquidity have developed in separate literature strands. According to Chorida, Sarkar, and Subrahmanyam (2005), the early studies of liquidity focus solely on the stock market due to the data availability issues. Among the earliest research in the given field one could mention Benston and Hagerman (1974), Glosten and Milgrom (1985), Seyhun (1986) and Amihud and Mendelson (1986). Glosten and Milgrom (1985) analyze the informational properties of transaction prices and the formation of bid-ask spreads adopting the adverse selection view to the insider trading phenomenon. Seyhun (1986) investigates the effect of insider trading on stock prices behavior and abnormal returns of informed traders. Both studies emphasize that insider

trading significantly influences stock market illiquidity. Butler, Grullon, and Weston (2005) is an example of a more recent work examining the stock market illiquidity from a perspective of the trading environment and frictions. The authors find that investment banks' fees are lower for companies whose stocks are liquid. In contrast to studies focusing mainly on the trading environment and institutional agreements, Naes, Skjeltorp and Odegaard (2011) examine bidirectional impact of the economic stance on the stock market liquidity. They compare the case of the USA and Norway and establish that stock market liquidity influences not only current, but also future state of the economy in the USA and Norway. The results received by the authors are robust to different liquidity proxies. Naes, Skjeltorp and Odegaard also show that there is Granger causality between liquidity and macroeconomic parameters in the given markets. Extending their idea, we investigate the bidirectional impact of the economic stance on the stock and bond market liquidity, volatility and returns in Russia. The research in this area was also performed by Kim (2013), who outlines that stock market illiquidity, in particular Amihud ratio, is an effective predictor of economic growth in Korea.

The idea of a joint analysis of volatility, liquidity and returns is not new. For instance, Andrikoupolos and Angelidis (2008) offer a pre-crisis analysis of the relations between volatility, illiquidity and returns on exchanges in advanced economies. The authors also conclude that there are volatility spillovers from large capitalization stocks to those with small capitalization and vice versa in London Stock Exchange. They establish that volatility shocks may be predicted by illiquidity shocks and return shocks. The authors also discuss illiquidity spillovers between large capitalization stocks and small capitalization stocks. Large capitalization stocks capture the effect first, while small capitalization stocks follow the pattern. Andrikoupolos, Angelidis, and Skintzi (2012) state that there are Granger-causal associations between volatility, illiquidity and returns of G-7 countries and within each country. The authors document that illiquidity and returns are negatively related in the majority of cases, and causal relationship between illiquidity and volatility is valid only for American market. Chang, Faff, and Hwang (2011) examine the dependency of liquidity, stock returns and the business cycle phase in Japan. The authors report that there is solely negative relationship between liquidity proxies and stock returns in Japanese market during the business cycle expansionary phase, while for the contractionary phase the results are ambiguous. Overconfidence hypothesis is likely to explain turnover/return relationship in Japan.

Stocks and bonds' trading activities follow completely different trading patterns due to the assets' specific features and suitability of the given assets for various strategies. Among other things, the latter yields, different speed of responsiveness of bond and stock market liquidity to changes in macroeconomic situation. For both types of assets the effect of macroeconomic variables and announcements on the market liquidity has been extensively analyzed. Brandt and Kavajecz (2002) study the dependence of liquidity, order flow and yield curve and make the conclusion that order flow imbalances explain 26% of the yield curve variation, and the impact of order flow on yields is the most evident in times of low liquidity. Fleming and Remolona (1999) and Balduzzi, Elton, and Green (2001) examine returns, spreads, and trading volume in the fixed income markets around financial announcements. Fleming and Remolona (1999) find that macroeconomic announcements have greater effect on expected future interest rate than on current short-term interest rates, and various types of announcements result in different expectations about the target rate. Balduzzi, Elton, and Green (2001) mention that adjustment of price volatility to news occurs within a minute, while bid-ask spreads widen and adjust to normal values only in 15 minutes after announcements. In addition, the authors state that the effect of macroeconomic announcements on bond market differs significantly depending on the assets' maturity; the statement is also supported by Beber, Brandt, and Kavajecz (2009), Longstaff (2004) and Goyenko and Ukhov (2009). Therefore, the analysis in this research also focuses on different bond maturities. Goyenko, Subrahmanyam and Ukhov (2011) outline that bond illiquidity influences the asset allocation efficiency and interest rate discovery. Moreover, dynamics of the bond markets' trading costs is very important for understanding investors' cost optimization. Interestingly, illiquidity becomes higher during recession periods across all maturities. However, the effect is stronger for short-term bonds. The difference between spreads of various maturity fixed income instruments also becomes more significant during the times of economic downturn for both on-the-run and off-the-run issues. The macroeconomic parameters' impact on the dealer costs has more importance in the less liquid off-the-run sector. On-the-run illiquidity is heavily influenced only by volatility, while off-the-run illiquidity is affected by inflation, monetary policy surprises, bond returns, and volatility. Off-the-run illiquidity is a key determinant for returns forecasting, and thus the liquidity premium, in the Treasury market. Nowadays, the studies of stock and bond markets illiquidity have developed in separate strands. However, there are also papers that provide

combined analysis of stock and bond markets illiquidity and describe the intuition behind their comovement — Chrorida, Sarkar, Subrahmanyam (2005), Goyenko and Uhov (2009). These papers apply vector autoregression analysis for the US market.

Although the studies of stock and bond markets illiquidity to some extent still constitute two separate literature strands, some researches have attempted to bridge the gap between them and provide a combined analysis of stock and bond markets illiquidity. Chrorida, Sarkar, Subrahmanyam (2005), Goyenko and Uhov (2009) model a joint dynamics of the US stock and bond markets within a vector autoregression framework and provide the intuition behind these markets' comovement. Various authors establish the existence of an illiquidity spillover between the stock and bond market (see for instance: Chrorida, Sarkar, & Subrahmanyam, 2005; Fleming, Kirby, & Ostdiek, 1998; Ho & Stoll, 1993; O'Hara & Oldfield, 1996). According to Goyenko and Ukhov (2009), there is mutual Granger causality between illiquidity of stock and Treasury bonds markets in the United States. Trading activity may result in the interaction between stock and fixed income market illiquidity (Fox, 1999; Swensen, 2000; Longstaff, 2004; Goetzman & Mazza, 2002; Agnew & Balduzzi, 2005). The impact of stock market illiquidity on those of the bond market is consistent with flight-to-quality and flight-to-liquidity episodes. At the same time, illiquidity of short-term bonds has a stronger effect on the stock market (Goyenko & Ukhov, 2009). The choice of the instruments by market participants depends heavily on the stage of economic cycle, bond maturity and date of the fixed income instrument issue (Goyenko, Subrahmanyam, & Ukhov, 2011). Amihud and Mendelson (1986) report that market participants are willing to pay for liquidity. Since illiquidity is a systematic risk factor, therefore illiquidity in one market may affect illiquidity in another market (Chrorida, Roll, & Subrahmanyam, 2000; Hasbrouck & Seppi, 2001; Huberman & Halka, 2001; Amihud, 2002; Pastor & Stambaugh, 2003; Amihud & Mendelson, 1986, 1989; Brennan & Subrahmanyam, 1996; Warga, 1992; Boudoukh & Whitelaw, 1993; Kamara, 1994; Krishnamurthy, 2002; Goldreich, Hanke & Nath, 2005; Goyenko & Ukhov, 2009; Brunnermeier & Pedersen, 2009). Vayanos (2004) outlines that illiquid assets become riskier whereas investors' risk aversion increases over time. Interestingly, Brunnermeier and Pedersen (2009) indicate that Federal Reserve can improve market liquidity by monetary policy actions. Fleming, and Remolona (1997) and Fair (2002) report that monetary shocks are accompanied by significant changes in stock and bond prices. Lesmond (2005) mentions that weak political institutions and legal enforcement system have a negative impact on the markets' liquidity. Chrorida,



Sarkar, and Subrahmanyam (2005) show that expansionary monetary policy results in higher stock market liquidity during recessions, and unexpected increases (decreases) in the federal funds rate lead to increases (decreases) in stock and bond volatility. In addition, the authors state that the flows in the stock and government bonds sectors are useful for stock and fixed income markets liquidity prediction thus establishing the link between "macro" liquidity, or money flows, and "micro", or transaction-based, liquidity in the American market.

Actually, Chorida, Sarkar, and Subrahmanyam (2005) find that volatility is an important driver of liquidity. Innovation in the spreads in one market affects the spreads in another market; therefore it is possible to conclude that liquidity and volatility are driven by the common factors.

This study focuses on the liquidity, not on volatility, because liquidity belongs to a more complex field of research. Various authors offer different measures of liquidity and its explanatory factors. There is also no consensus on the best liquidity indicator. Moreover, suitability of the indicators is determined by the asset type and data frequency. In addition, there is less data available for liquidity measures' computation. The following sections provide a discussion of the most commonly employed measures of liquidity and its drivers, behavior of the Russian financial market as well as the modern financial markets' forecasting techniques based on the information available online.

### 1.1 LIQUIDITY MEASURES

Liquidity is a key notion in financial markets studies, but as it was mentioned above, there are some difficulties with its measurement. Low-frequency price impact proxies described by Goyenko, Holden and Trzcinka (2009) include return-to-volume ratio of Amihud (2002), Pastor and Stambaugh (2003) and Amivest Liquidity (Amihud, Mendelson & Lauterbach, 1997). Goyenko, Holden and Trzcinka (2009) outline that Amihud (2002) is effective for capturing price impact and high-frequency transaction costs benchmarks in NYSE. Florackis, Gregoriou and Kostakis (2011) introduce another low-frequency liquidity measure not mentioned by Goyenko, Holden and Trzcinka (2009) that is the return-to-turnover ratio. Florackis, Gregoriou and Kostakis (2011) notice that asset pricing is significantly influenced by trading frequency and transaction costs — the above-mentioned factors are not considered in isolation, and emphasize that return -to-turnover ratio separates size effect from illiquidity effect as compared to Amihud (2002) thus being a more accurate measure. Lesmond (2005) reports that volume and turnover-based measures

are downward-biased for low-liquidity markets. This research uses low frequency price impact benchmark for stock illiquidity measurement similar to those presented by Florackis, Gregoriou and Kostakis (2011) and simplified low frequency spread benchmark as bond illiquidity proxy. The formula for the bond illiquidity proxy is provided in Methodology section.

### 1.2 FACTORS INFLUENCING THE RUSSIAN STOCK MARKET BEHAVIOR

Apparently, the first econometric study modeling the Russian stock market is due to Rockinger and Urga (2000) who state that the Russian market has a tendency to exhibit the market efficiency. Initially, most research has concentrated on market returns and volatility and employed models ranging from GARCH (Hayo & Kutan, 2005; Goriaev & Sonin, 2005), EGARCH (Jalolov & Miyakoshi, 2005), TGARCH (Hayo & Kutan, 2005) to non-parametric approach to event studies (Chesney, Reshetar, & Karaman, 2011). Generalized Autoregressive Conditional Heteroskedasticity or GARCH framework, an extension of ARCH model, is typically used to model time series variance (Engle, 1982; Bollerslev, 1986). EGARCH and TGARCH are examples of asymmetric GARCH models introduced by Nelson (1991) and Zakoian (1994) respectively. Goriaev and Zabotkin (2006) report high influence of "corporate governance, political risk and macroeconomic risk factors such as emerging markets performance, oil prices and exchange rates on the Russian stock market". They stress that significant sensitivity of developing markets to political events may jeopardize the growth prospects, and macroeconomic factors that have significant impact in the developed markets become significant in the volatile emerging markets only after corporate governance reaches the proper level of quality and transparency. Furthermore, investors' over-reaction or under-reaction to certain events in highly volatile markets additionally contributes to the risk of the assets in addition to country- and firm-specific risks. Therefore, static models are not suitable for markets with high level of risk, and dynamic models should be applied. Anatolyev (2005) emphasizes a structural — not depending on the financial crises — instability of the Russian market, and a growing importance for the Russian market of such explanatory factors as the US stock prices as well as the US and Russian interest rates. Nevertheless, according to Anatolyev the influence of the exchange rates, oil prices and monetary aggregates on the Russian stock market returns diminished in years 2003 and 2004. Interestingly, Jalolov and Miyakoshi (2005) suggest that German market is more efficient predictor for the Russian stock mar-

ket monthly returns. In their view, this fact could be attributed to relatively close trade and investment relations between Germany and the Russian Federation. Surprisingly, the authors do not report a strong dependence between oil and gas prices and the Russian stock market returns. In contrast, Hayo and Kutan (2005) find that the Russian market returns may be explained by their own lagged values as well as the S&P 500 return and oil index return and thus reject the EMH for the Russian stock market. The authors also establish a direct volatility link between the Russian and US markets.

### 1.3 GOOGLE TRENDS AND OTHER TYPES OF ONLINE INFORMATION AS MODERN FORECASTING TOOLS

In the world of advanced technological development people tend to resort to the online information sources in many aspects of their life, including investment decision making. With a growing role of internet searches a valid research question is whether internet searches can help predict market behavior and what would be the rationale behind their forecasting capacity. Preis, Moat, and Stanley (2013) argue that Google Trends data may reflect the current state of the economy and provide some insights to the future behavior of the economic actors. The authors state that there is an increase in the search for key words connected with the financial market before the financial market falls, so it is possible to construct trading strategies based on the volume of internet queries. Financial relevance of each term is calculated as a frequency of each term in the online edition of *Financial Times* newspaper normalized by the number of Google hits. In addition, Preis, Moat, and Stanley (2013) determine that Google search volume in the US is a better predictor for the US market price dynamics as compared with global Google search volume. Vlastakis and Markellos (2012) use Google Trends as information demand quantification and empirically confirm that information demand is positively related to investors' risk aversion. The authors also obtain that demand for idiosyncratic information influences individual stock trading volume and excess stock returns. The usefulness of the Google search volume is not solely confined to the US market. Arouri *et al.* (2013) indicate that Google Trends tool is useful for the liquidity forecasting in French stock market. Adding information demand variables to their model helps improve it. In addition to Google Trends variables the authors use the following parameters as liquidity forecasting factors: absolute returns, firm size, information supply, risk and trading costs.

Apart from the liquidity forecasting, the Google search volumes have been examined with respect to

their applicability in the market volatility and price dynamics prediction. Da *et al.* (2011), Dzielinski (2011) outline that internet search volume data may be effectively used for stock market volatility forecasting. Dimpfl and Jank (2011) state that Google Trends may be efficiently employed for forecasting volatility in the UK, US, French and German markets. They show that adding internet search queries variables to the model leads to more precise in- and out-of-samples forecasts. Moreover, Dimpfl and Jank find strong co-movement of stock indexes' volatilities and internet queries for their names. In their models volatility is an exogenous factor owing to the fact that first and subsequent internet queries are considered as a consequence of the strong primary fundamental volatility shock following the logic of Lux and Marchesi (1999). Our empirical strategy relies on all the market microstructure variables being endogenous and the global factors being exogenous both for microstructure variables and internet queries.

## 2. METHODOLOGY AND MODEL SELECTION

This study aims to assess the impact of the asset characteristics and internet searches on the returns and liquidity in the Russian stock and bond markets. The purpose of the research is to determine whether market microstructure parameters are useful for forecasting liquidity, volatility and return and if internet searches may be successfully employed to forecast the market microstructure characteristics. In particular, the following hypotheses are examined:

**Ho (1):** Individual asset or asset classes' characteristics are irrelevant for the Russian financial markets' liquidity and returns forecasting.

**Ho (2):** Internet search time series is irrelevant for the Russian stock market liquidity and returns forecasting.

**Ho (3):** Changes in macroeconomic variables do not influence the Russian stock and bonds' market return, liquidity and volatility.

Our empirical strategy involves the correlation analysis, the Granger causality tests and the vector autoregression models built for daily, weekly and monthly data. For correlation analysis Spearman method is used, because the data might not be normally distributed which is typical for the given type of research. In order to demonstrate non-normal distribution of data the Empirical Distribution Function Test for Normality is performed. The testing procedure is based on the statistics of Lilliefors (1967, 1969), Cramer – von Mises (1928) and Anderson and Darling (1952, 1954). The null hypothesis is that data is normally distributed.

### 3. DATA DESCRIPTION

This study uses daily, weekly and monthly data for the period between 2006 and 2015. The data has been obtained from Bloomberg database, MICEX official website, Google, *Yahoo!* Finance, Bank of Russia and Federal Service of State Statistics web sites.

### 4. CHARACTERISTICS OF INDIVIDUAL ASSETS OR ASSET CLASSES

In weekly data model the following variables are analyzed: stock market return measure (RETURN), stock market illiquidity measure -the higher the factor is, the less liquid the market is (LIQUIDITY), stock market volatility measure (VOLATILITY). RETURN, VOLATILITY and LIQUIDITY are calculated based on time series for MICEX closing prices from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015. The data sources are MICEX official web site and Bloomberg.

In daily data analysis the following variables are used: stock market return measure (RETS), short-term bonds return (RETBS), medium-term bonds return (RETBM), long-term bonds return (RETBL), stock market volatility (VOLS), short-term bonds volatility (VOLBS), medium-term bonds volatility (VOLBM), long-term bonds volatility (VOLBL), stock illiquidity (ILLIQS), short-term bonds illiquidity (ILLIQBS), medium-term bonds illiquidity (ILLIQBM), long-term bonds illiquidity (ILLIQBL).

RETS, VOLS, ILLIQS are calculated based on the MICEX time series closing prices for the period from the 1<sup>st</sup> of August 2012 to the 27<sup>th</sup> of February 2015. The data sources are MICEX official website and Bloomberg.

The period for bond microstructure parameters is from the 1<sup>st</sup> of August 2012 to the 27<sup>th</sup> of February 2015. RETBS, VOLBS, ILLIQBS are calculated for closing prices time series for 7.5% federal loan bonds (OFZ) with maturity on the 15<sup>th</sup> of March 2018 (approximately 3 years to maturity). The data source is Bloomberg. RETBM, VOLBM, ILLIQBM are calculated for closing prices time series for 7.6% federal loan bonds (OFZ) with maturity on the 20<sup>th</sup> of July 2022 (approximately 7 years to maturity). The data source is Bloomberg. RETBL, VOLBL, ILLIQBL are calculated for closing prices time series for 10% federal loan bonds (OFZ) with maturity on the 20<sup>th</sup> of August 2025 (approximately 10 years to maturity). The data source is Bloomberg.

In monthly data analysis the following market microstructure parameters are used: stock return (RETS), stock volatility (VOLS), stock illiquidity (ILLIQS) that are calculated based on the MICEX closing prices time series from April 2011 to February 2015. The data sources are MICEX official web site and Bloomberg data base.

Short term bonds return (RETBS), short term bonds volatility (VOLBS), short term bonds illiquidity (ILLIQBS) are calculated for closing prices time series for 7.5% federal loan bonds (OFZ) with maturity on the 15<sup>th</sup> of March 2018 (approximately 3 years to maturity). The data source is Bloomberg data base.

As in Goyenko and Ukhov (2009) the bond illiquidity measure is calculated as:

$$\frac{(ASK - BID)}{0.5 (ASK + BID)}$$

Following Amihud (2002), Florackis, Gregoriou and Kostakis (2011), the stock illiquidity measure is defined as:

$$\frac{1}{\text{number of valid observation days}} * \frac{\text{Absolute value of return}}{\text{Turnover}}, \text{ where}$$

$$\text{Turnover} = \frac{\text{Total number of shares traded during the period}}{\text{Average number of shares outstanding during the period}}$$

The stock volatility and bond volatility are measured as standard deviation of their returns. For the convenience of work with data natural log of turnover time series is taken (return data is expressed in percentage terms, and turnover in 8-digit numbers). Volatility is calculated as a standard deviation for the previous 22 observations for daily data (number of working days per month), and as a standard deviation for the previous 4 observations for weekly data. Return for monthly data is calculated as averages of daily returns for a specified month. For volatility and liquidity the last observations for a specified month are taken.

**4.1 INTERNET SEARCH PARAMETERS**

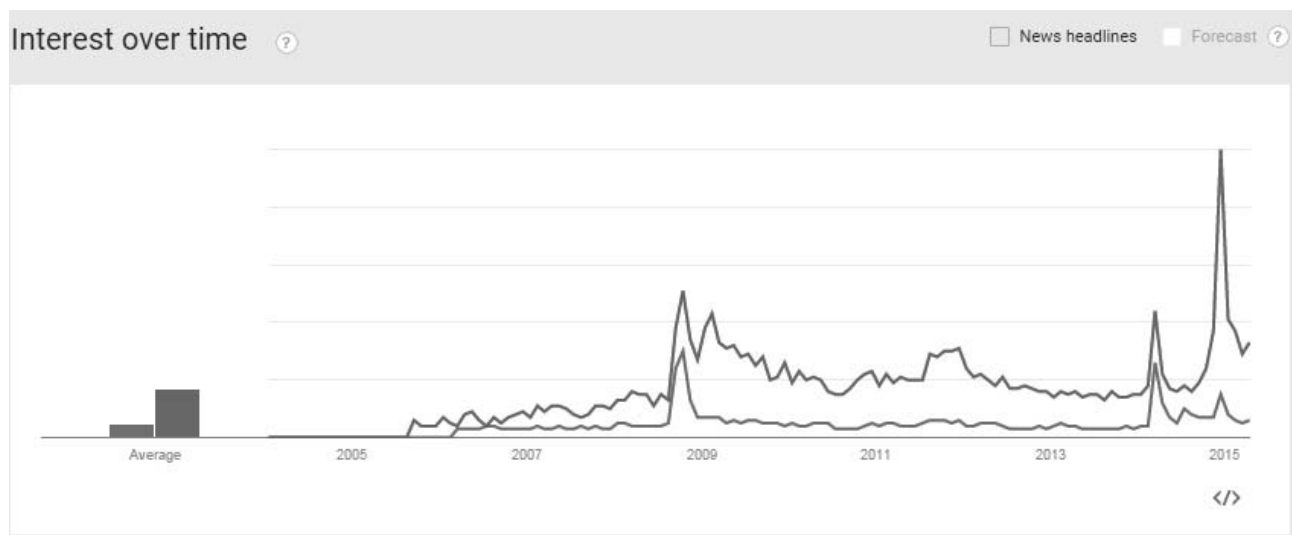
Internet search measures included in the weekly data model are stock market internet queries in English language (GOOGLE\_MICEX) and stock market internet queries in Russian language (GOOGLE\_MMVB). GOOGLE\_MICEX gives the number of searches done for a term "MICEX" relative to the total number of searches done on Google over time from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015. GOOGLE\_MMVB gives the number of searches done for a term "MMB5" (MICEX name in the Russian language) in the relative to the total number of searches done on Google over time from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015. The data source is Google Trends – the statistics available online for weekly data. Unfortunately, there is no open access to daily data. Monthly GOOGLE\_MMVB and GOOGLE\_MICEX are calculated as monthly av-

erage of weekly time series for the period from April 2011 to February 2015.

Google Trends shows a percentage of Google searches to define the number of queries made for selected terms as compared to the total quantity of Google searches done during that period. The data is normalized with respect to total searches in order to avoid variable’s effect and to allow comparisons across regions. Therefore it is expressed in relative terms. Data is presented on a scale from 0–100 (Google, 2015).

From the given chart it is possible to make the conclusion that the query "MMB5" was more common in Google than the query "MICEX".

The interest for the Russian stock market is demonstrated not only in Moscow and Saint Petersburg, but also in top two global financial centers London and New York (Z/Yen, 2015). The absence of interest



**Figure 4.2.1.** Interest over Time – MICEX Query (Lower graph) vs. MMB5 Query (Upper graph) in Google Trends.

Source: Google (2015).



**Figure 4.2.2.** Regional Interest for "MICEX" by Country (End of April 2015).

Source: Google (2015).

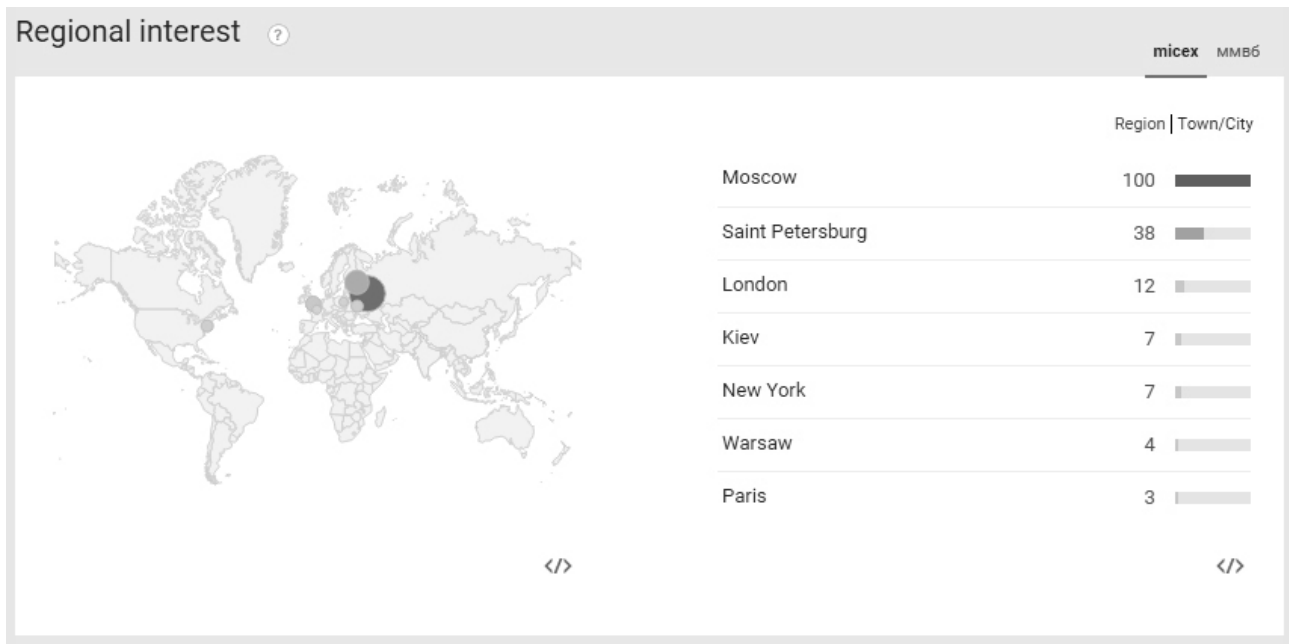


Figure 4.2.3. Regional Interest for "MICEX" by City (End of April 2015).

Source: Google (2015).

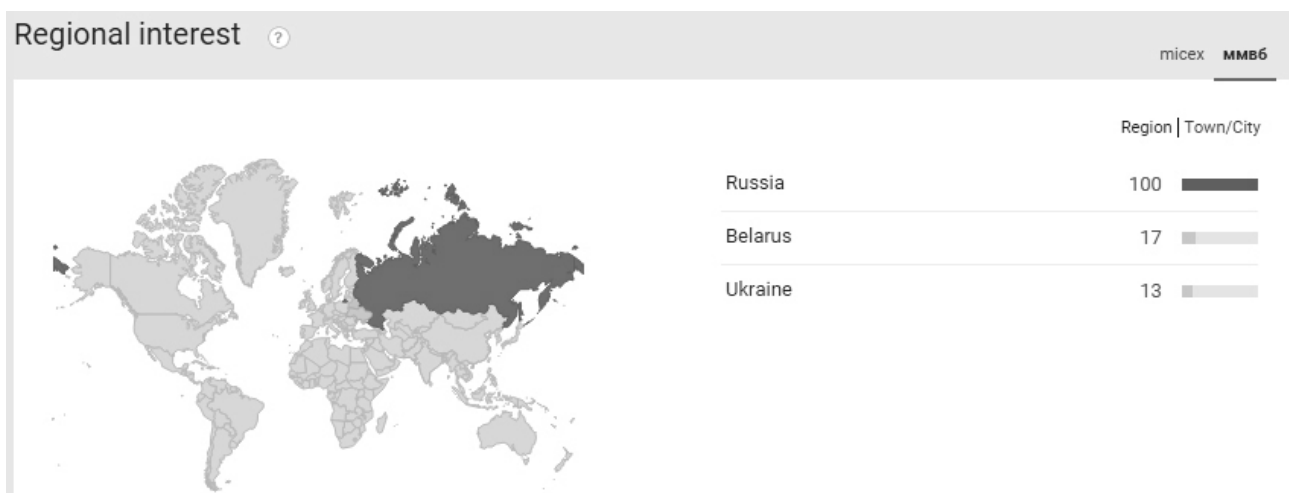


Figure 4.2.4. Regional Interest for "MMB5" by Country (End of April 2015).

Source: Google (2015).

in Asia, in particular in China, may be explained by the fact that Google cannot gather statistics from the given markets due to political reasons.

High interest for the Russian version of "MICEX" query in the analyzed period was demonstrated in Moscow, St. Petersburg, Kaliningrad, Siberia and Central Russia cities, as well as in CIS countries such as Ukraine and Belarus. The latter may be explained by the high share of the Russian-speaking population living there.

**4.2 GLOBAL FACTORS**

In order to control for the global factors affecting the Russian bond and stock markets, the daily, weekly and monthly models are augmented by the oil prices,

as well as S&P 500 returns (prices). The choice of the control variables is based on Anatolyev (2005), Hayo and Kutan (2005), Goriaev and Zobotkin (2006). In weekly data analysis OIL stands for United States Oil ETF quotes from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015. The investment traces "the performance, less expenses, of the spot price of West Texas Intermediate (WTI) light, sweet crude oil". (Yahoo! Finance, 2015). USA means S&P 500 quotes from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015 – American stock market index including 500 companies with the highest market capitalization (Yahoo! Finance). USCHANGE is S&P 500 return calculated as log-difference of S&P 500 time series from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015.

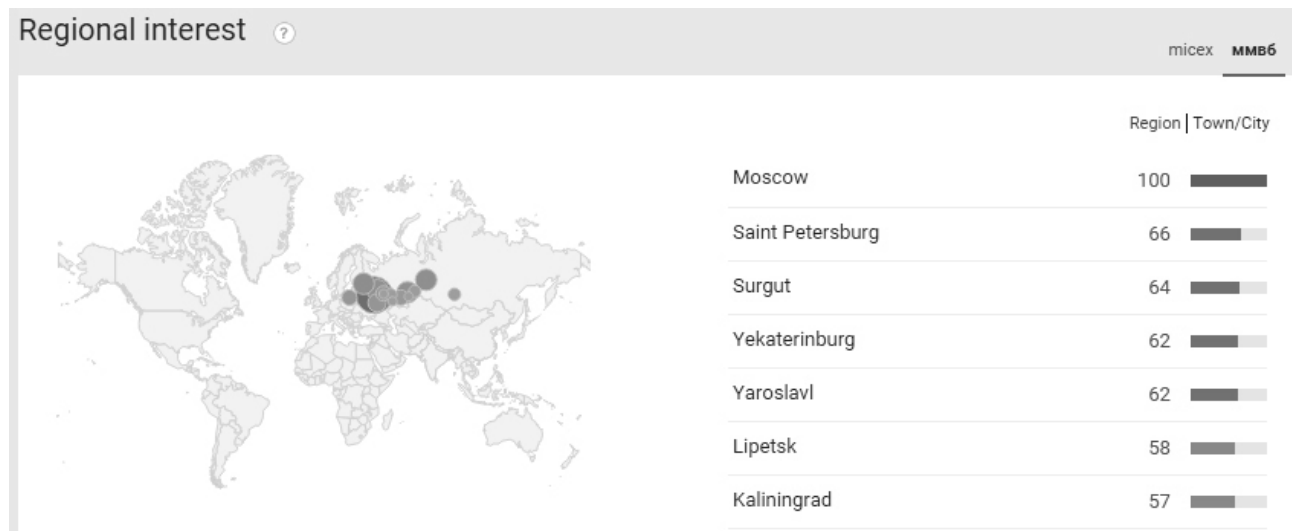


Figure 4.2.5. Regional Interest for "MMB5" by City (End of April 2015).

Source: Google (2015).

Global factors used in daily data analysis are OIL and USA. OIL stands for United States Brent Oil ETF from the 1<sup>st</sup> of August 2012 to the 27<sup>th</sup> of February 2015. The investment "reflects, net of expenses, the daily changes in percentage terms of the spot price of Brent crude oil" (Yahoo! Finance, 2015). By USA we denote S&P 500 quotes from the 1<sup>st</sup> of August 2012 to the 27<sup>th</sup> of February 2015 (Yahoo! Finance).

The global factor used in the monthly data model is the S&P 500 monthly return (USCHANGE) from April 2011 to February 2015.

### 4.3 MACROECONOMIC VARIABLES

The choice of macroeconomic parameters used in weekly and daily data analysis follows Goriaev and Zabotkin (2006). RUB/USD stands for exchange rates for the period from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015 (Bank of Russia). RUB/EUR describes exchange rates for the period from the 21<sup>st</sup> of April 2006 to the 27<sup>th</sup> of February 2015 (Bank of Russia). In daily data analysis macroeconomic variables such as RUB/USD that is exchange rates for the period from the 1<sup>st</sup> of August 2012 to the 27<sup>th</sup> of February 2015 (Bank of Russia), and RUB/EUR describing exchange rates for the period from the 1<sup>st</sup> of August 2012 to the 27<sup>th</sup> of February 2015 (Bank of Russia), are employed.

The monthly data analysis covers the period from April 2011 to February 2015. The choice of macroeconomic variables follows Goyenko and Ukhov (2009) that performed similar analysis in the US market. Inflation is calculated as log-differences of CPI (consumer price index). The source of CPI data is Federal Service of State Statistics. Industrial Production (IP) change is calculated as log-differences of Industrial Production. IP is the index of goods and services out-

put for basic types of economic activities. It is calculated on the basis of the data on the physical output change in the following spheres: agriculture, mining (natural resources extraction), manufacturing, production and distribution of electricity, gas and water, construction, transport, wholesale and retail trade — calculated as a ratio of two considered periods in the base period prices. The data source is Federal Service of State Statistics. International reserves change (INT\_RES\_DIF) is calculated as first differences of International Reserves. International Reserves are defined as the sum of currency reserves and monetary gold. Source of data is Bank of Russia. MIBOR is the first-difference of 1-day Moscow Interbank Offered Rate. MIBOR is an indicative rate of the ruble loan provision in Moscow Interbank Market. MIBOR is chosen for the analysis as it is sensitive to changing environment and reflects the macroeconomic situation in Russia.

## 5. RESULTS

We first present the outcome of tests examining the features of the employed time series, and then discuss the core results of our analysis.

### 5.1 TESTING TIME SERIES FEATURES

#### 5.1.1 Unit Root Tests

In the given study stationarity term is used in the weak stationarity context. Weakly stationary random process requires only autocovariance and the first moment not to vary over time (Enders, 2010). The stationarity of time series is tested using so-called unit root tests. The Augmented Dickey-Fuller test, despite being criticized, continues to be the most

widely used unit root test. Therefore, stationarity of the time series analyzed in this study is tested with the help of the Augmented Dickey Fuller statistic (Dickey & Fuller, 1979; MacKinnon, 1991, 1996). The conclusions are drawn at the 5% significance level. The below given tables summarize the outcome of the ADF tests.

For weekly data GOOGLE\_MICEX, VOLATILITY, RETURN and USCGHNAGE are stationary time series, while GOOGLE\_MMVB and LIQUIDITY are level stationary S&P 500 prices and exchange rates time series are not stationary, therefore vector autoregression analysis and Granger causality test cannot be applied on them. For daily data ILLIQS, AMERICA and VOLBS are level stationary. As we can see, global oil prices (OIL) and exchange rates time series are not stationary. In such a case, the Granger causality test cannot be applied, and at the same time it is not advisable to conduct vector autoregression analysis for non-stationary data. Although, it is typically possible to eliminate the stochastic trend by first-differencing the data. Sims (1980) does not recommend it for the VAR effectiveness purposes. The rest of the variables are stationary. For monthly data S&P 500 return, GOOGLE\_MICEX, VOLBS and VOLS are level stationary, GOOGLE\_MMVB is stationary, the rest of the variables are stationary.

## 5.2 CORRELATION ANALYSIS

Prior to proceeding with the correlation analysis we test whether the data is normally distributed. The type of data determines the type of correlation test which needs to be employed. For all weekly and daily time series employed in this study the null hypothesis of normally distributed data is rejected at the 5% significance level. Among monthly time series only the change of international reserves (IR change), the change of industrial production (IP change) and the stock returns (RETS) are normally distributed. For the

return of the short-term bonds (RETBS) the null hypothesis is not rejected at the 5% significance level in accordance with Lilliefors p-value only. The rest of the variables prove to be not normally distributed at the 5% significance level. What follows, in order to detect the dependency between data, we employ robust to non-normality Spearman's rank correlation test.

The significance of the correlation coefficients is also tested. Below we present the discussion of statistically significant correlation relationships.

As we can see from the table, there is a very high positive correlation between internet search queries for MICEX both in Russian (GOOGLE\_MMVB) and in English (GOOGLE\_MICEX) languages (. Both types of the internet queries are positively correlated with volatility and to lesser extent with illiquidity. This may be an indicator of investors' higher interest in the financial instrument in times of uncertainty, when it experiences significant price fluctuations. Internet queries are negatively correlated with oil prices and positively with exchange rates. It means that the general public demonstrates a higher interest in the Russian economy in times, when the economy experiences problems (falling oil prices as well as ruble depreciation). Interestingly, the absolute values for correlation coefficients are higher for GOOGLE\_MICEX despite the fact that MMVB ("MMBF") is a more popular query in Google than "MICEX". This may suggest that stock market professionals, who actually make transactions in the market, use tickers with the names in English, or that the English-speaking (possibly Western) investment community has more influence on the Russian market performance.

Oil price dynamics shows almost no correlation with the US market. There is a strong negative correlation between the global oil prices and the exchange rates. As expected, the exchange rates RUB/USD and RUB/EUR demonstrate a strong positive correlation.

**Table 5.2.1.** The Results of Correlation Analysis for Weekly Time Series on the Russian Stock Market and Internet Queries in the Period from 2006 to 2015.

	GOOGLE_MMVB	GOOGLE_MICEX	LIQUIDITY	OIL	RETURN	VOLATILITY	USA	RUBUSD	RUBEUR
GOOGLE_MMVB	1,00	0,70	0,15	-0,50	0,01	0,26	-0,28	0,51	0,62
GOOGLE_MICEX	0,70	1,00	0,18	-0,44	-0,09	0,27	-0,12	0,50	0,59
LIQUIDITY	0,15	0,18	1,00	0,09	0,07	0,24	-0,23	-0,07	-0,03
OIL	-0,50	-0,44	0,09	1,00	-0,05	0,08	-0,04	-0,82	-0,70
RETURN	0,01	-0,09	0,07	-0,05	1,00	0,08	-0,01	0,08	0,07
VOLATILITY	0,26	0,27	0,24	0,08	0,08	1,00	-0,41	-0,07	-0,03
USA	-0,28	-0,12	-0,23	-0,04	-0,01	-0,41	1,00	0,25	0,19
RUBUSD	0,51	0,50	-0,07	-0,82	0,08	-0,07	0,25	1,00	0,86
RUBEUR	0,62	0,59	-0,03	-0,70	0,07	-0,03	0,19	0,86	1,00

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo! Finance and the Bank of Russia.

In accordance with the correlation matrix above, there is less interest in the Russian market in times of American market positive price dynamics. We can observe a negative correlation between the US market and the following indicators: Russian market illiquidity and volatility, positive correlation with the exchange rates. There is almost no correlation of the US market and oil price dynamics. When the ruble depreciates against the American and the European currencies, the Russian market becomes more liquid and less volatile, and demonstrates better returns. It may be explained by the fact that MICEX includes high share of the natural resources' exporters that benefit from the national currency depreciation.

Illiquidity is positively correlated with volatility. The logic behind such a phenomenon could be the following: in highly volatile times people tend to make less transactions, because risk averse investors usually feel uncertainty about the assets, while the number of speculators that realize their strategies in expectation of higher returns is not too high. In times of increasing returns the majority of investors that already owned the asset tend to keep it, whereas the general public usually purchases the asset. Of course, there are also value investors using sophisticated models, very experienced technical analysts or people having inside information that act against the market, but their share is quite low. These arguments partially draw upon Dow Theory that originates from 255 Wall Street Editorials written by C.H. Dow (1851–1902) and discusses the phases of market trends.

The US market (S&P 500 price dynamics) demonstrates a positive correlation with the Russian short-term and medium-term bonds' illiquidity and to a lesser extent with the illiquidity of the Russian stocks and long-term bonds. Returns of the Russian medium term bonds market are negatively correlated with the American market. The correlation between the exchange rates and American market is very close

to one, which suggests that the dynamics identified for the weekly data has become more evident in the recent years. The volatility of the Russian medium-term and short-term bonds' markets as well as the Russian stock market volatility are positively correlated with the American market. It may be explained by the fact that American market performance is a leading indicator for the majority of the economies. The US market is well developed, and many financial innovations appear in America. Improper use of the innovative financial tools such as speculation and fraud may lead to the financial crisis. One example of such phenomenon is the subprime mortgage crisis of 2007–2010 that originated in the USA, and then had strong negative impact on large number of countries all over the world. It is worth to mention that Russian long-term bonds' market volatility has zero correlation with the US market. The oil price has an evident negative correlation with the illiquidity of the Russian bonds, especially long-term, and volatility of the Russian stocks and medium-term bonds. The situation with the exchange rates is similar to those identified on weekly data, but herein the trend is less evident. Still, such a result supports the well-established belief that an increase in oil prices contributes to the stability of the Russian economy. Oil prices have also a negative correlation with the US market, but not too strong. The correlation of the oil prices with the rest of the variables is close to zero. Illiquidity of the Russian long-term bonds is positively correlated with all variables apart from the oil price, but the absolute values of the correlation coefficients are not very high. It could suggest that this asset is relatively insensitive to external shocks. Illiquidity of the Russian short-term and medium-term bonds demonstrate relatively strong correlation with each other. The given variables also have an evident positive correlation with the American market, the exchange rates as well as the medium-term and short-term bond vola-

**Table 5.2.2.** The Results of Correlation Analysis for Daily Time Series on the Russian Stock and Bond Markets in the period from 2012 to 2015.

	AMERICA	ILLIQBS	ILLIQS	ILLIQBM	ILLIQBL	OIL	RETBL	RETBM	RETBBS	RETS	RUBEUR	RUBUSD	VOLBL	VOLBM	VOLBS	VOLS
AMERICA	1,00	0,42	0,16	0,50	0,12	-0,10	-0,03	-0,09	-0,08	0,06	0,93	0,92	0,00	0,58	0,63	0,46
ILLIQBS	0,42	1,00	0,18	0,45	0,09	-0,17	0,01	-0,02	0,01	0,07	0,50	0,49	0,10	0,47	0,42	0,39
ILLIQS	0,16	0,18	1,00	0,19	0,12	-0,13	0,04	-0,04	0,05	0,04	0,18	0,19	0,02	0,24	0,17	0,32
ILLIQBM	0,50	0,45	0,19	1,00	0,12	-0,21	-0,03	0,00	0,00	0,03	0,56	0,58	0,06	0,56	0,41	0,45
ILLIQBL	0,12	0,09	0,12	0,12	1,00	-0,40	0,03	0,06	0,02	0,02	0,13	0,11	0,09	0,21	0,11	0,27
OIL	-0,10	-0,17	-0,13	-0,21	-0,40	1,00	0,01	0,00	0,02	-0,01	-0,14	-0,20	-0,08	-0,32	-0,01	-0,28
RETBL	-0,03	0,01	0,04	-0,03	0,03	0,01	1,00	0,02	0,08	0,03	-0,04	-0,03	0,00	0,00	-0,01	-0,01
RETBM	-0,09	-0,02	-0,04	0,00	0,06	0,00	0,02	1,00	0,34	0,25	-0,08	-0,06	0,10	0,00	0,01	0,02
RETBBS	-0,08	0,01	0,05	0,00	0,02	0,02	0,08	0,34	1,00	0,14	-0,07	-0,06	0,02	-0,01	0,00	0,01
RETS	0,06	0,07	0,04	0,03	0,02	-0,01	0,03	0,25	0,14	1,00	0,06	0,06	0,06	0,08	0,09	0,02
RUBEUR	0,93	0,50	0,18	0,56	0,13	-0,14	-0,04	-0,08	-0,07	0,06	1,00	0,97	0,08	0,66	0,72	0,51
RUBUSD	0,92	0,49	0,19	0,58	0,11	-0,20	-0,03	-0,06	-0,06	0,06	0,97	1,00	0,02	0,68	0,68	0,55
VOLBL	0,00	0,10	0,02	0,06	0,09	-0,08	0,00	0,10	0,02	0,06	0,08	0,02	1,00	0,08	0,40	-0,07
VOLBM	0,58	0,47	0,24	0,56	0,21	-0,32	0,00	0,00	-0,01	0,08	0,66	0,68	0,08	1,00	0,60	0,67
VOLBS	0,63	0,42	0,17	0,41	0,11	-0,01	-0,01	0,01	0,00	0,09	0,72	0,68	0,40	0,60	1,00	0,41
VOLS	0,46	0,39	0,32	0,45	0,27	-0,28	-0,01	0,02	0,01	0,02	0,51	0,55	-0,07	0,67	0,41	1,00

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo!Finance and the Bank of Russia.



**Table 5.2.3.** The Results of Correlation Analysis for Monthly Time Series on the Russian Stock and Bond Markets and Macroeconomic Variables for the Period from 2011 to 2015.

	GOOGLE_MICEX	INT_RES_DIF	GOOGLE_MMVB	ILLIQBS	ILLIQS	INFLATION	RETBS	RETS	VOLS	VOLBS	IPCHANGE	MIBOR CHANGE	USCHANGE
GOOGLE_MICEX	1,00	-0,35	0,73	0,34	0,19	0,10	-0,23	-0,11	0,53	0,54	-0,10	0,17	0,10
INT_RES_DIF	-0,35	1,00	-0,30	-0,43	0,06	-0,07	0,00	-0,38	0,05	-0,47	0,36	-0,06	-0,11
GOOGLE_MMVB	0,73	-0,30	1,00	-0,01	0,30	0,20	-0,06	0,00	0,63	0,37	-0,02	0,15	0,19
ILLIQBS	0,34	-0,43	-0,01	1,00	-0,17	0,13	-0,16	0,10	-0,08	0,62	-0,08	0,11	0,06
ILLIQS	0,19	0,06	0,30	-0,17	1,00	0,05	0,05	-0,26	0,41	-0,05	0,14	-0,10	-0,03
INFLATION	0,10	-0,07	0,20	0,13	0,05	1,00	-0,02	0,14	0,23	0,32	-0,05	0,20	0,15
RETBS	-0,23	0,00	-0,06	-0,16	0,05	-0,02	1,00	0,60	-0,20	-0,05	-0,11	-0,16	-0,01
RETS	-0,11	-0,38	0,00	0,10	-0,26	0,14	0,60	1,00	-0,24	0,30	-0,31	-0,03	0,22
VOLS	0,53	0,05	0,63	-0,08	0,41	0,23	-0,20	-0,24	1,00	0,16	-0,02	0,10	0,12
VOLBS	0,54	-0,47	0,37	0,62	-0,05	0,32	-0,05	0,30	0,16	1,00	-0,06	-0,04	0,20
IPCHANGE	-0,10	0,36	-0,02	-0,08	0,14	-0,05	-0,11	-0,31	-0,02	-0,06	1,00	-0,24	0,16
MIBOR	0,17	-0,06	0,15	0,11	-0,10	0,20	-0,16	-0,03	0,10	-0,04	-0,24	1,00	-0,18
USCHANGE	0,10	-0,11	0,19	0,06	-0,03	0,15	-0,01	0,22	0,12	0,20	0,16	-0,18	1,00

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo!Finance and the Bank of Russia.

tilities and the stock market volatility. In addition to being positively correlated with the US market, Russian stock market illiquidity demonstrates positive correlation with the short-term, medium-term and long-term bond markets' illiquidity, exchange rates, short-term and medium term, stock market volatilities. There is a negative correlation with oil prices and almost no correlation of the Russian stock market and the other variables. RUB/USD and RUB/EUR have a positive correlation with the assets' volatilities; volatilities are also positively correlated among themselves.

For the pairs of variables describing the market microstructure daily data correlation analysis is considered primary, because of the time series' higher frequency, the absence of transformations and the focus on a more recent time period. The results for the correlation analysis of the internet searches in English (GOOGLE\_MICEX) and in Russian (GOOGLE\_MMVB) with the stock market microstructure parameters are consistent with the results obtained for the weekly data. GOOGLE\_MICEX and GOOGLE\_MMVB are also positively correlated with the short-term bonds volatility. One of the possible explanations of this phenomenon is that the queries for the main Russian stock market index result in higher interest in all assets offered in the Russian market including the short-term bonds, because Google offers the users a wide range of the market reviews in response to the given query — investors are likely to read the news related not only to one specific asset, but also to other instruments in the considered market. Certain differences in the correlation coefficients absolute values for the internet searches in English (GOOGLE\_MICEX) and in Russian (GOOGLE\_MMVB) may be explained by a different degree of influence of queries in various languages discussed in previous sections.

A change in international reserves is negatively correlated with the internet queries for the Russian

stock market, short term bonds' illiquidity and volatility, stock return, and positively correlated with the industrial production change. We observe that the inflation is positively correlated with short term bonds' volatility. Russian stock market return shows positive correlation with S&P 500 return.

### 5.3 GRANGER CAUSALITY ANALYSIS

First we present the results of the Granger causality test for the weekly data. Schwarz Information Criterion (BIC) suggests choosing 3 lags, Hannan Quinn Information Criterion — 4 lags, Forecast Prediction Error — 11 lags, AIC — 12 lags, while the sequential modified LR test statistic suggests choosing 17 lags. The maximum number of lags specified for the lag selection is 20. Since each lag selection criterion suggests a different number of lags (p) to be included, we discuss various specifications. However, we pay a particular attention to SBIC and HQIC. As demonstrated by Lutkepohl (2005), choosing p to minimize SBIC or HQIC provides consistent estimates of the true lag order, while minimizing AIC or FPE tends to overestimate the true lag order with a positive probability, even with an infinite sample size.

As the impact of internet searches has not been yet tested for the Russian market, we start our discussion of the Granger causality test with the Google searches. GOOGLE\_MICEX Granger causes stock market liquidity (LIQUIDITY). There is also a bidirectional causality between GOOGLE\_MICEX and stock market return (RETURN). For lags 3 and 4 a bidirectional Granger causality arises for GOOGLE\_MICEX and stock market volatility. It means that internet search queries in English may be used as a leading indicator for volatility and liquidity, but in case of stock market return it is difficult to determine, which factor is primary. There is a bidirectional Granger causality between GOOGLE\_MICEX and oil prices. It is likely that internet queries specifically for oil

**Table 5.3.1.** Pairwise Granger Causality Tests for Weekly Data.

3 lags		X						
Y	LIQUIDITY	VOLATILITY	RETURN	OIL	GOOGLE_MICEX	GOOGLE_MMVB	USCHANGE	
LIQUIDITY								
VOLATILITY								
RETURN								
OIL								
GOOGLE_MICEX								
GOOGLE_MMVB								
USCHANGE								

4 lags		X						
Y	LIQUIDITY	VOLATILITY	RETURN	OIL	GOOGLE_MICEX	GOOGLE_MMVB	USCHANGE	
LIQUIDITY								
VOLATILITY								
RETURN								
OIL								
GOOGLE_MICEX								
GOOGLE_MMVB								
USCHANGE								

Mutual influence
X influencing Y
Y influencing X
No influence
Already defined relationship

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo!Finance and the Bank of Russia.

would be more illustrative for oil prices prediction. GOOGLE\_MMVB Granger causes stock market volatility. GOOGLE\_MMVB Granger causes stock market liquidity with the lag of up to 3 weeks. With lags up

to 3 weeks GOOGLE\_MMVB is Granger caused by stock market return. Oil prices Granger cause GOOGLE\_MMVB. Summarizing, GOOGLE\_MMVB is a less powerful forecasting indicator than "MICEX" query.

**Table 5.3.2.** Pairwise Granger Causality Tests for Daily Data.

1 lag		X											
Y	ILLIQBL	ILLIQBM	ILLIQBS	ILLIQS	RETB	RETB	RETB	RETS	VOLBL	VOLBM	VOLBS	VOLS	USA
ILLIQBL													
ILLIQBM													
ILLIQBS													
ILLIQS													
RETB													
RETB													
RETB													
RETS													
RETS													
VOLBL													
VOLBM													
VOLBS													
VOLS													
USA													

Mutual influence
X influencing Y
Y influencing X
No influence
Already defined relationship

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo!Finance and the Bank of Russia.

The logic behind such result confirms the arguments used for the interpretation of the correlation analysis: queries in English tend to be used more often by investment professionals and in English-speaking countries, while queries in Russian are generated by general public in Russia and CIS.

The S&P 500 index Granger causes Russian stock market liquidity and return with up to 3-week lag and stock market volatility with up to 3- and 4-week lag, while for higher lag order a mutual Granger causality arises. Finally, as in Lee and Hao (2012) we obtain that oil prices Granger cause the S&P 500 index change.

For the daily data FPE and AIC criteria suggest choosing 7 lags. SC and HQ information criteria suggest choosing 1 lag, while LR test statistic indicates 22 lags. The maximum number of lags specified for the lag selection is 25.

Our analysis shows that Granger causality relationships are highly sensitive to the choice of lags. We should treat our results with a caution since as shown in McCrorie and Chambers (2004) the temporal aggregation can influence Granger causality test results. Nev-

ertheless, the obtained sensitivity to the lag choice is in line with Anatolyev (2005) conjecture saying that the Russian market is structurally unstable. It is necessary to mention that the nature of Granger causality relationships differs from those in the US market researched by Goyenko and Ukhov (2009).

For the monthly data the modified LR test statistic and Schwarz Information Criterion suggest choosing 1 lag, while FPE, AIC and HQ suggest choosing 2 lags.

### 5.4 VECTOR AUTOREGRESSION ANALYSIS

We start with the model incorporating the internet searches that is with the weekly data model. The model endogenous variables are internet queries in English language for MICEX index (GOOGLE\_MICEX), internet queries in Russian language (GOOGLE\_MMVB), stock market liquidity (LIQUIDITY), stock market return (RETURN), and stock market volatility (VOLATILITY). The exogenous variables are global oil prices (OIL), and the S&P 500 return (USCHANGE). The global factors were made exogenous from theoretical considerations. The number of lags to be selected suggested by LR-criterion is 17. VAR satis-

**Table 5.3.3.** Pairwise Granger Causality Tests for Monthly Data.

1 lag		X										
Y	GOOGLE_MICEX	INT_RES_DIF	ILLIQBS	ILLIQS	INFLATION	RETBS	RETS	VOLS	VOLBS	IPCHANGE	MIBOR CHANGE	USCHANGE
GOOGLE_MICEX												
INT_RES_DIF												
ILLIQBS												
ILLIQS												
INFLATION												
RETBS												
RETS												
VOLS												
VOLBS												
IPCHANGE												
MIBOR CHANGE												
USCHANGE												

2 lags		X										
Y	GOOGLE_MICEX	INT_RES_DIF	ILLIQBS	ILLIQS	INFLATION	RETBS	RETS	VOLS	VOLBS	IPCHANGE	MIBOR CHANGE	USCHANGE
GOOGLE_MICEX												
INT_RES_DIF												
ILLIQBS												
ILLIQS												
INFLATION												
RETBS												
RETS												
VOLS												
VOLBS												
IPCHANGE												
MIBOR CHANGE												
USCHANGE												

Mutual influence
X influencing Y
Y influencing X
No influence
Already defined relationship

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo:Finance and the Bank of Russia.

fies the stability condition and shows no significant autocorrelation in residuals of the model at the 1% significance level. Appendix 2 features the details of all diagnostic tests conducted for the discussed vector autoregression models. Next, we employ the following ordering of the variables for the Cholesky decomposition: GOOGLE\_MICEX, GOOGLE\_MMVB, VOLATILITY, RETURN, LIQUIDITY. We start with the 'local' shocks and forecasting tools GOOGLE\_MICEX and GOOGLE\_MMVB. We give the priority to GOOGLE\_MICEX as Granger causes more variables than GOOGLE\_MMVB. VOLATILITY, RETURN, LIQUIDITY ordering is chosen in accordance with Goyenko and Ukhov (2009) for future comparison purposes. The period for IRF-construction is 52 weeks — the approximate number of weeks in a year.

LIQUIDITY shows a series of low amplitude positive fluctuations in response to the innovation in VOLATILITY, and a series of low amplitude negative fluctuations in response to the shock in RETURN. The fluctuations last less than half a year. The results are consistent with those received by Chorida, Roll, and Subrahmanyam (2001) and Goyenko and Ukhov (2009) for the US market, however the shocks in American market last more than a year. Russian stock market liquidity also exhibits an instantaneous high amplitude positive response to its own shock followed by low amplitude fluctuations that last less than half a year.

Finding the appropriate model with stationary time series, stable and with no serial correlation in residuals posed a certain challenge for the case of daily data. It is probable that these specific features of time series reflect the rest mature nature of the Russian market as compared to the US market. The endogenous variables are medium term bonds illiquidity (ILLIQBM), short term bonds illiquidity (ILLIQBS), stock market illiquidity (ILLIQS), stock market return (RETS), and short term bonds return (RETBS). The endogenous variables are determined using the block exogeneity test with the 5% significance level. The exogenous variables are S&P 500 prices (AMERICA1). As suggested by LR-criterion, the model includes 22 lags. VAR satisfies the stability condition, and shows no significant autocorrelation in residuals of the model at the 1% significance level. The ordering of the variables for the Cholesky decomposition follows Goyenko and Ukhov (2009) and is as follows: RETBS, RETS, ILLIQS, ILLIQBM, ILLIQBS.

For daily data we consider impulse responses for up to 22 days, which is approximate number of work-

ing days per month. Similar to the result for weekly data, in case of daily data we observe that the effect of shocks in the Russian market is much shorter than in the US market. Typically shock effects last no longer than one year, and significant fluctuations are present in first several months up to half a year. Medium term bonds illiquidity shows a negative response that lasts from the seventh to eighteenth day following the shock in RETS, which is consistent with the results received by Chorida, Roll, and Subrahmanyam (2001), Goyenko and Ukhov (2009) who studied American market. Stock market illiquidity shows almost no response to the shock in medium term bonds illiquidity in the Russian market, while in the US market researched by Goyenko and Ukhov (2009) the response of stock illiquidity to innovation in medium-term bonds illiquidity is negative.

Stock illiquidity shows almost no response to the shock in short term bonds illiquidity, while in accordance with Goyenko and Ukhov (2009) the response is positive. Medium term bonds illiquidity shows evident positive response to the shock in short term bonds illiquidity in the fourth day, in the rest of the days there is almost no response. Short term bonds illiquidity shows an instantaneous positive response to its own shock that diminishes in the end of the fifth day.

Endogenous and exogenous variables for monthly VAR-model have been determined on the basis of theory and include global factors, monetary policy actions and macroeconomic variables which may have an impact on the local market microstructure. The opposite is also possible, certain policy actions may result from the market behavior. However, such situation is less likely, as monetary policy actions are usually aimed at the changing macroeconomic variables in the short run, and the market reacts to the given political decisions. As a result, the monthly VAR model features as endogenous variables stock market return (RETS), short term bonds market return (RETBS), stock market illiquidity (ILLIQS), short term bonds market illiquidity (ILLIQBS), stock market volatility (VOLS), short term bonds market volatility (VOLBS). Exogenous variables are the change in industrial production (IPCHANGE), S&P 500 return (USCHANGE), the change in international reserves (INT\_RES\_DIF), the change in 1 — day MIBOR (MIBOR), inflation, and monthly dummy variables which account for the seasonality. The Schwarz Information Criterion suggests to choose 1 lag. The VAR (1) satisfies the stability condition and shows no sign of autocorrelation in residuals at the 5% significance level. As the number of usable observations is not very high, the normal distribution of residuals is a very important indicator of the model quality. The null

<sup>1</sup> The results for the model, where US market returns are used instead of the prices are very similar.

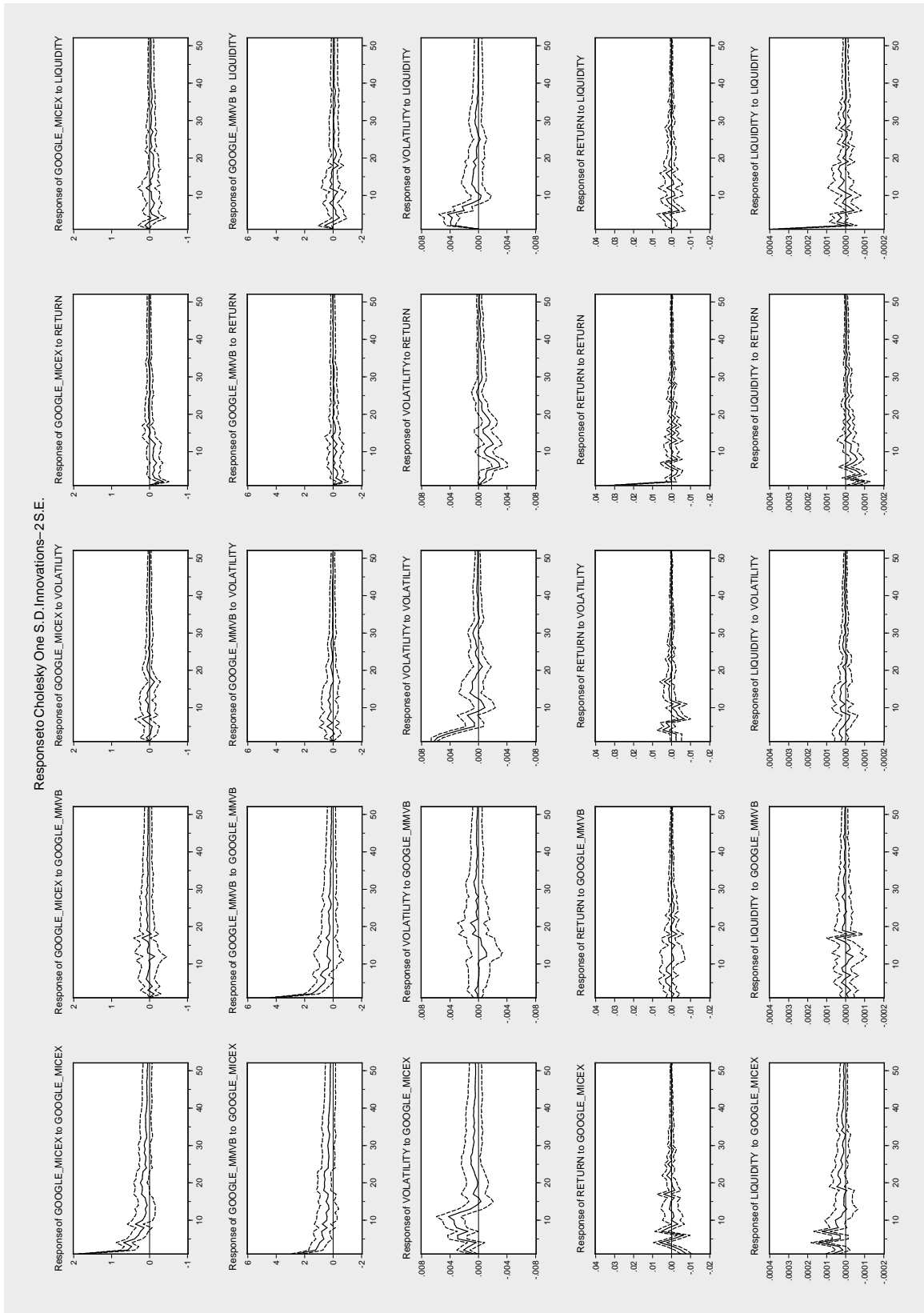


Figure 5.4.1. Impulse Response Functions for the Weekly Data VAR Model.

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo!Finance and the Bank of Russia.

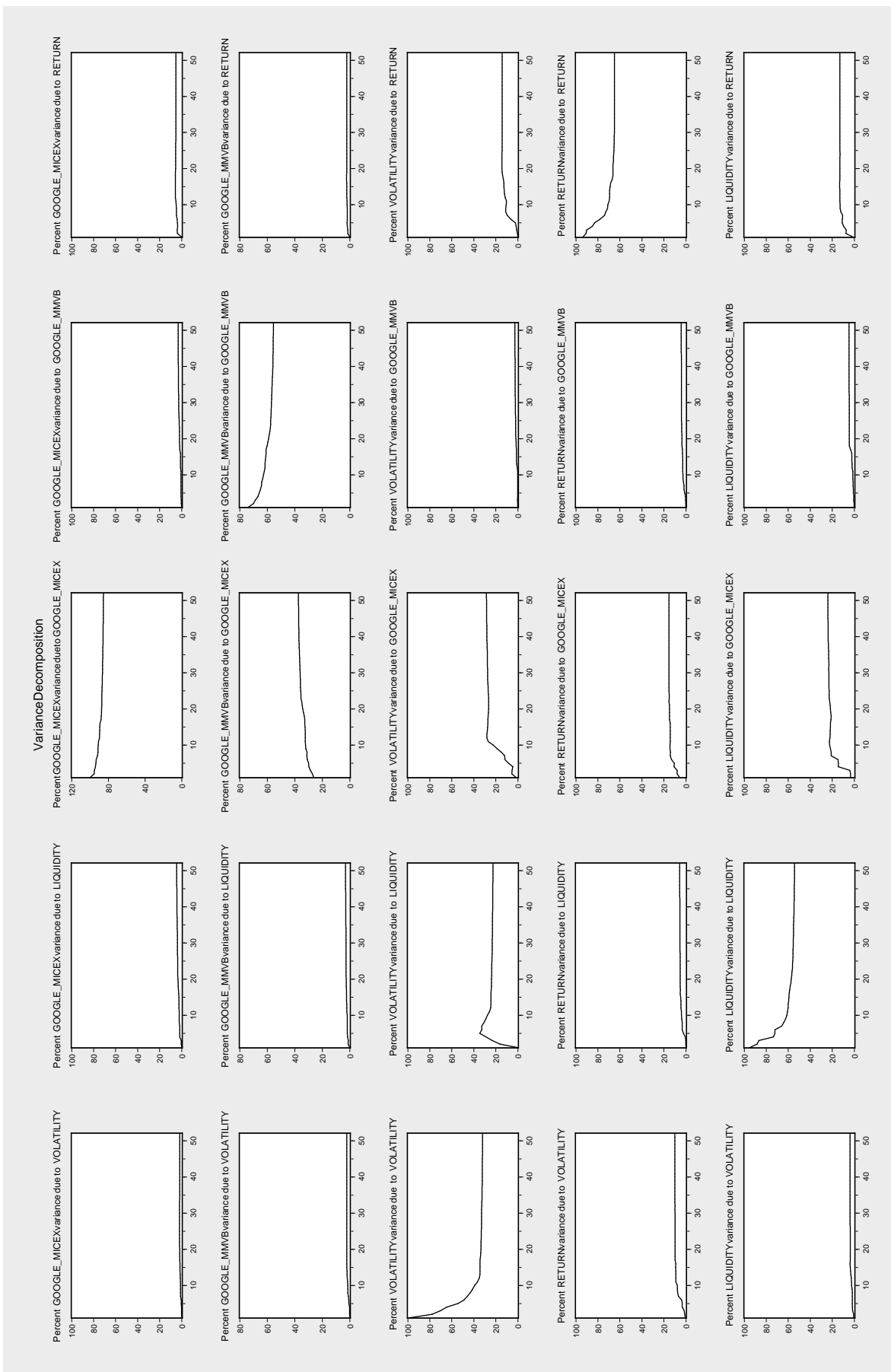
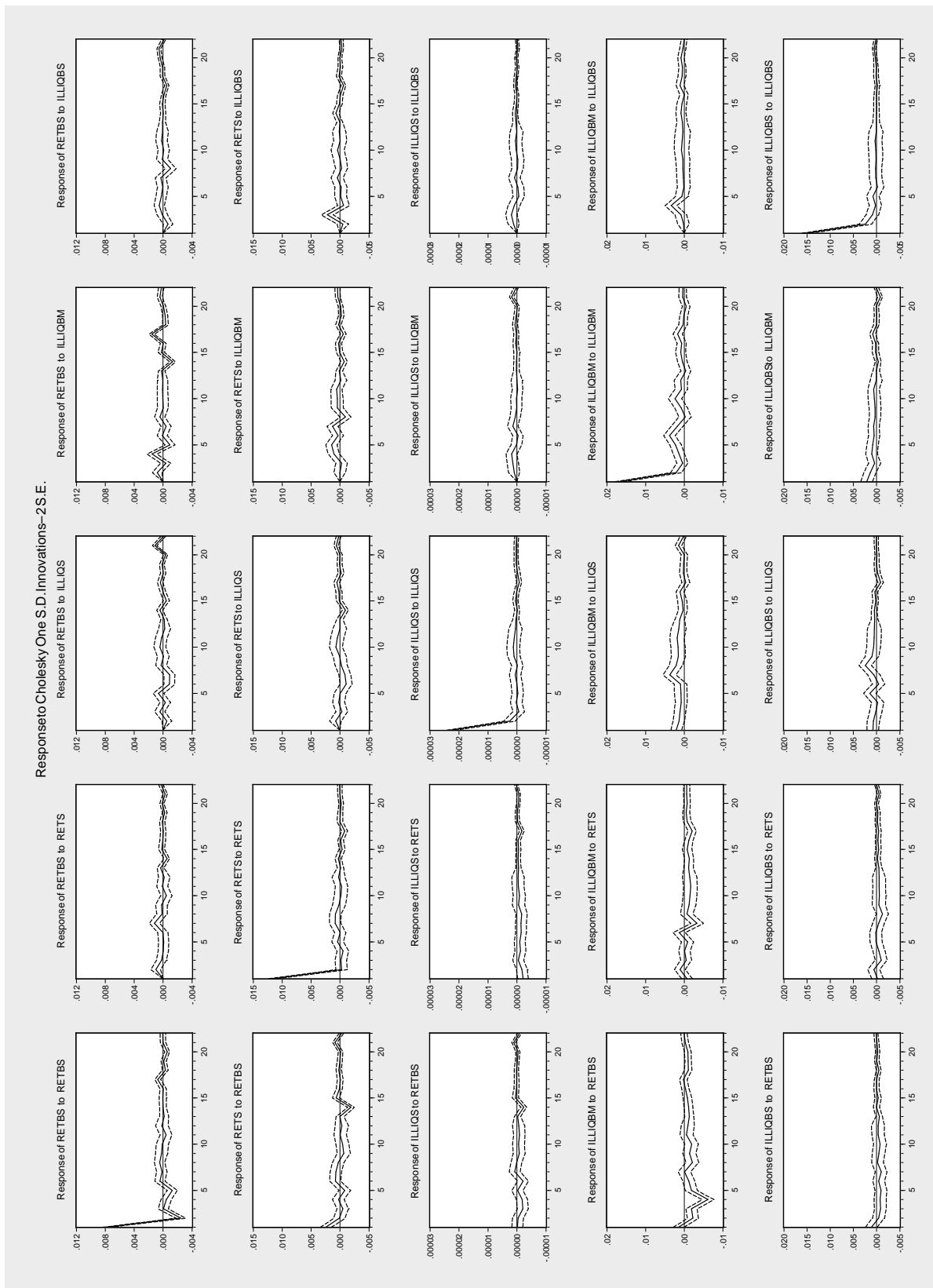


Figure 5.4.2. Forecast Error Variance Decomposition for the Weekly VAR Model..

Source: Own calculations based on the data retrieved from Google Trends, Bloomberg, Yahoo! Finance and the Bank of Russia.



**Figure 5.4.3.** Impulse Response Functions for the Daily Data VAR Model.

Source: Own calculations based on the data retrieved from Bloomberg database, Yahoo!Finance.

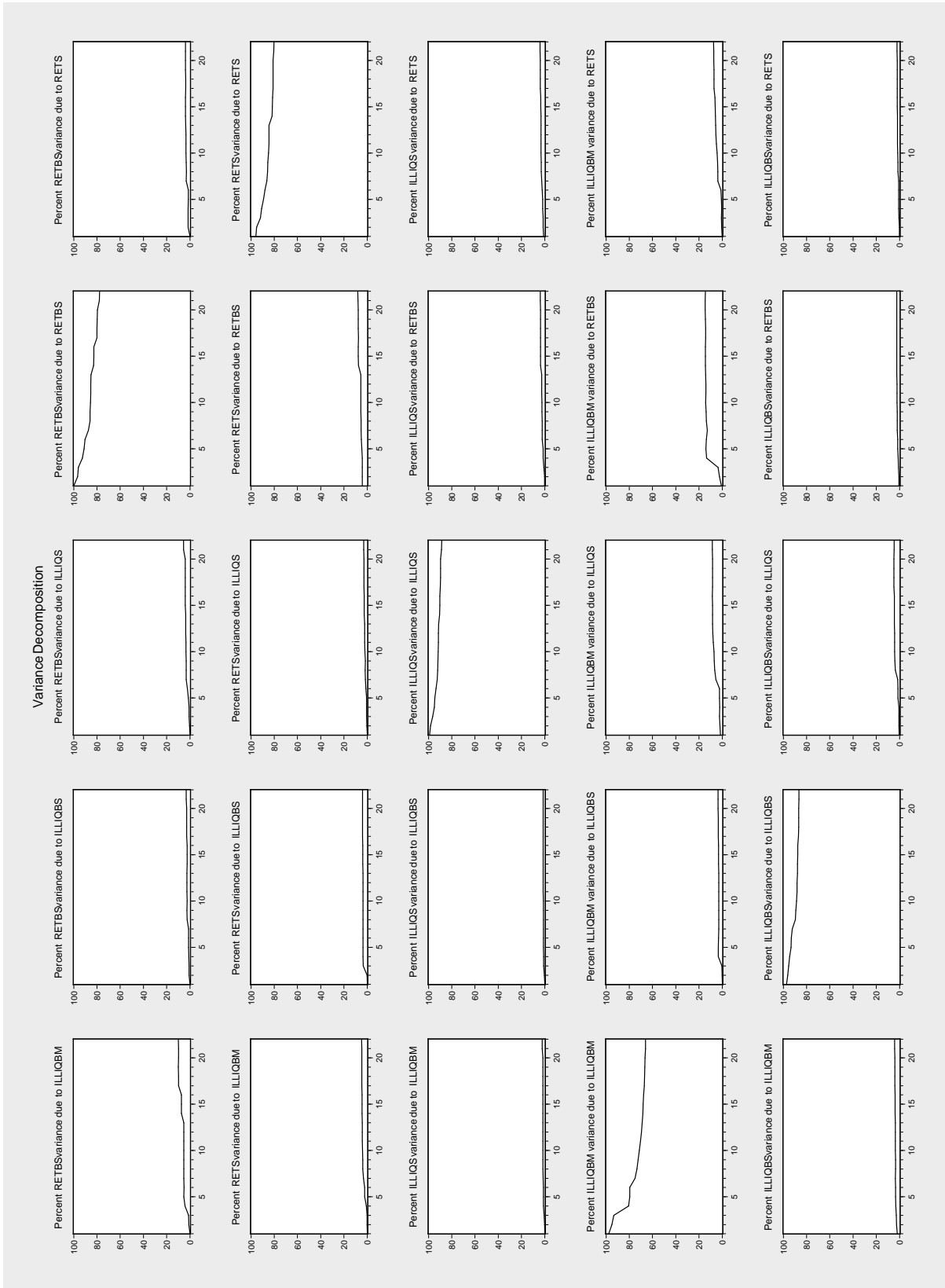
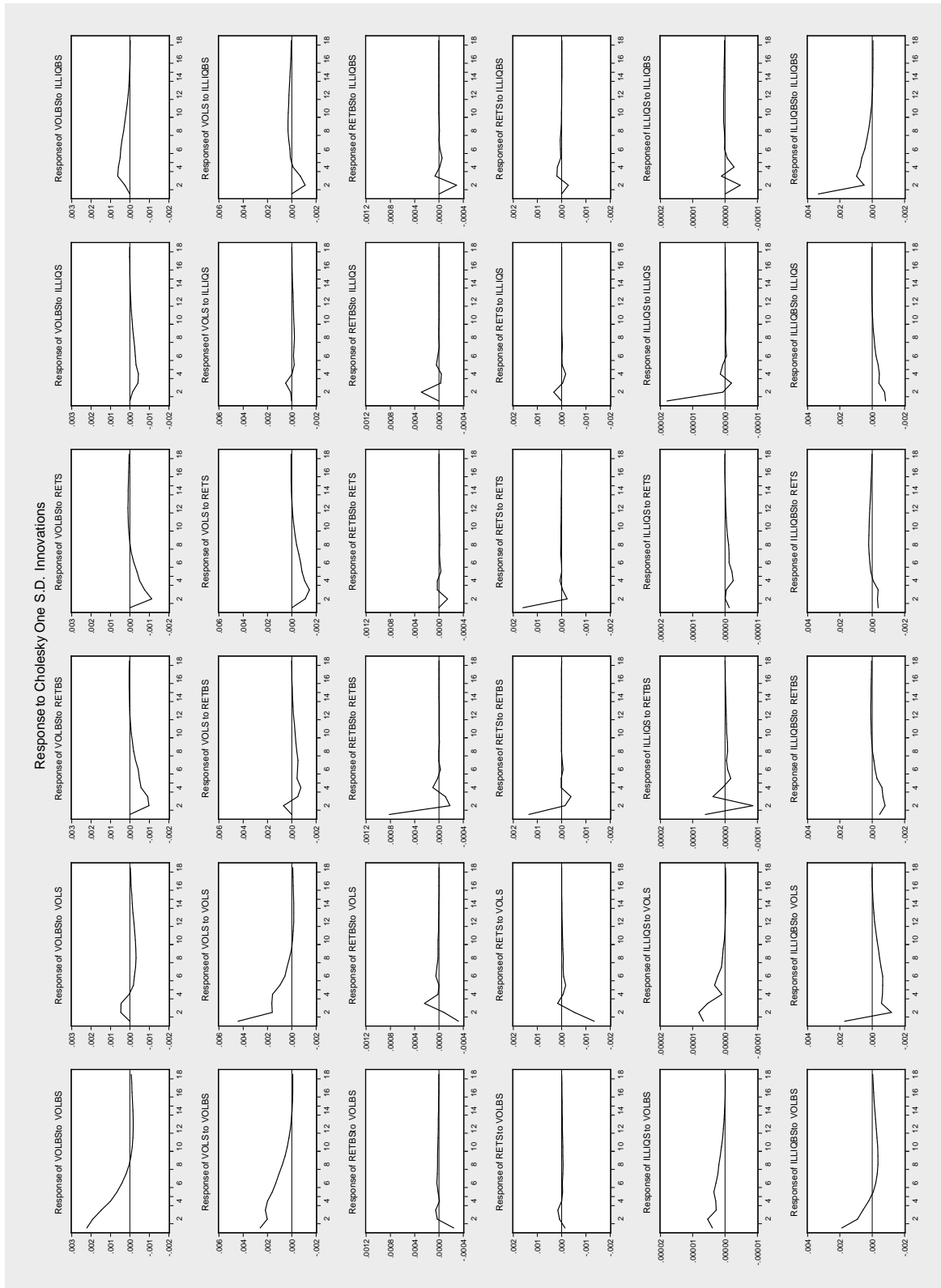


Figure 5.4.4. Forecast Error Variance Decomposition for the VAR Model for Daily Data.

Source: Own calculations based on the data retrieved from Bloomberg database, Yahoo.Finance.





**Figure 5.4.5.** Impulse Response Functions for the Monthly Data VAR Model.

Source: Own calculation based on the data retrieved from Google Trends, Bloomberg database, Yahoo!Finance, Bank of Russia, Federal Service of State Statistics.

hypothesis for Jarques – Bera test is not rejected at the 5% significance level, and the residuals prove to be multivariate normal. The ordering of the variables for the Cholesky decomposition follows Goyenko and Ukhov (2009): VOLBS, VOLS, RETBS, RETS, ILLIQS, ILLIQBS. The chosen period for IRFs construction is 18 months.

Stock illiquidity and short term bonds illiquidity show no response to the shock in stock return, while in the US market researched by Chorida, Roll, and Subrahmanyam (2001), Goyenko and Ukhov (2009) the responses are negative. The direction of response of stock illiquidity to short term bond illiquidity is opposite to those in the US market studied by Goyenko and Ukhov (2009).

It is possible to make the conclusion that illiquidity linkages in the Russian market are present, but still much weaker than those in the US market. In both markets bond maturity category matters for market microstructure variables relationships.

## 5.5 SUMMARY OF RESULTS

The results for weekly data Granger causality test and vector autoregression analysis do not support *Ho (1)* and *Ho (2)*, which means that the market microstructure parameters and internet searches are relevant for the Russian market liquidity and returns' forecasting. However, *Ho (2)* is not supported by monthly data Granger causality test. The results for daily and monthly data Granger causality tests, daily and monthly vector autoregression models also reject *Ho (1)*, which suggests that the market microstructure parameters are useful for the Russian market liquidity and returns' forecasting. The results for monthly data Granger causality test do not support *Ho (3)* as well. It means that macroeconomic variables may be effectively used for the Russian financial markets forecasting according to the tests with the lags of 1 or 2 months.

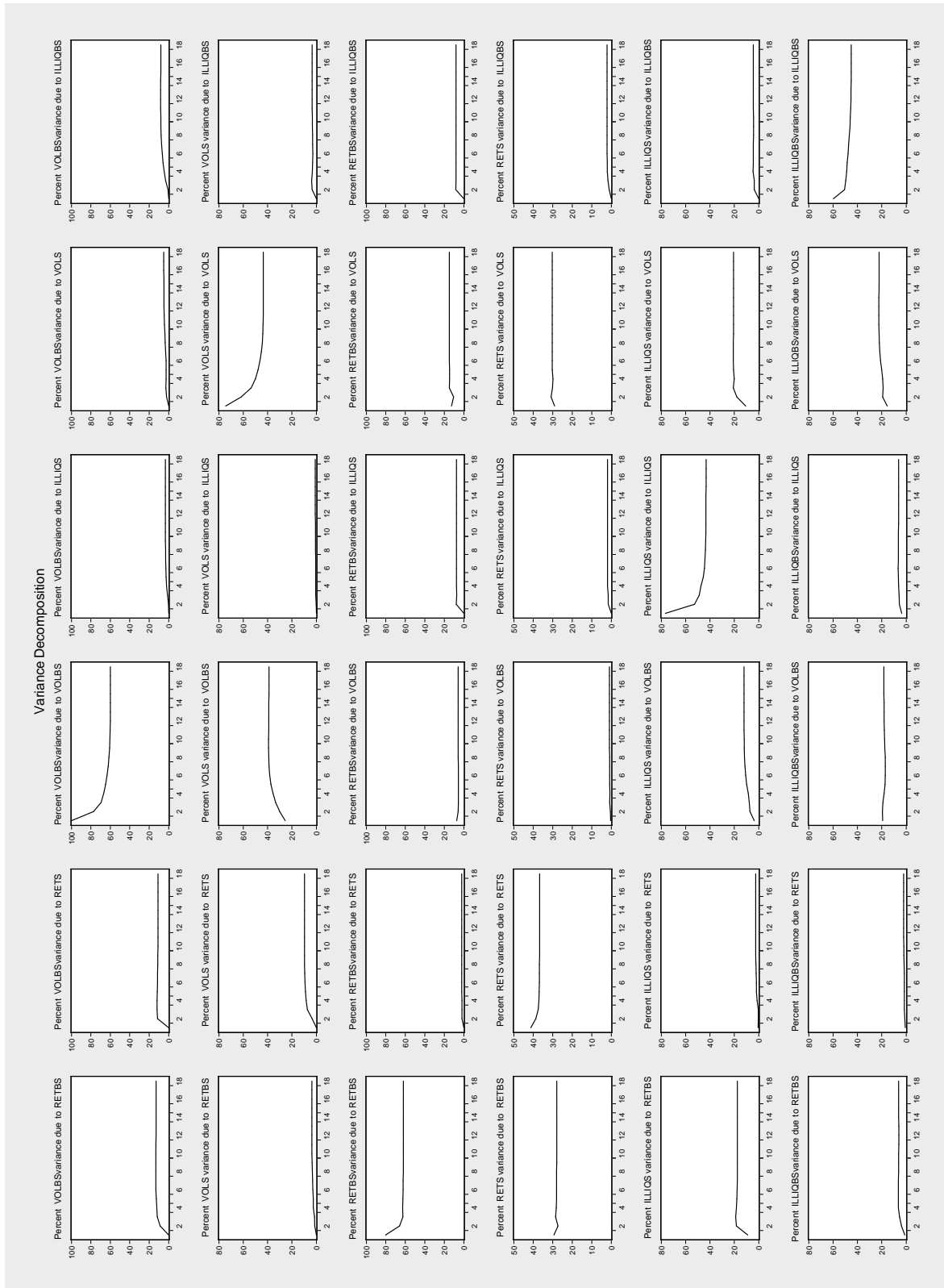
## 6. CONCLUSIONS

We find that despite the structural instability of the Russian financial markets, the market microstructure variables influence each other and are affected by the characteristics of other asset types. The nature of this influence is highly dependent on the model characteristics such as the lag selection or Cholesky ordering in case of vector autoregressions. This corroborates with the claim of Gorjaev and Zobotkin (2005) about the necessity of using the dynamic models in highly volatile markets and economies heavily influenced by political news. The stock and bond returns time series may be used for forecasting liquidity and volatility in the Russian market. This is supported by

the Granger causality test and vector autoregression analysis. However, the stock illiquidity is not useful for forecasting stock returns, which is in contrast to the results received by Jones (2001), Amihud (2002), Pastor and Stambaugh (2003) for the US market, and Andrikoupolos and Angelidis (2008) for the UK market. The discrepancy could be attributed not only to completely different type of the markets and their perception by the investment community, but also to differing importance of market microstructure factors. In the Western markets investors are likely to pay more attention to illiquidity, while in highly volatile markets risk is the most important factor for decision making. In accordance with the weekly VAR model, the stock illiquidity may be useful for volatility forecasting, but the stock market return and illiquidity do not Granger cause volatility. Similarly to the financial markets of G-7 countries researched by Andrikoupolos, Angelidis, and Skintzi (2012), in the Russian stock market liquidity, return and volatility in the majority of cases experience bidirectional Granger causal relationships. As opposed to the majority of G-7 countries stock markets, the Russian stock market does not demonstrate an evident negative relationship between liquidity and return. Nevertheless, there is a negative relationship between volatility and return indicating that in the Russian market investors rely on risk measures rather than on illiquidity measures in their decision-making process. Liquidity and volatility in the Russian stock market demonstrate Granger casual relationships that corroborates with the situation in the US market. The Russian market returns may be explained by their own shocks that correspond to the results received by Hayo and Kutan (2005). Bond maturity in the Russian market has a significant impact on the bonds' characteristics and implicitly on switching between different asset classes. Such a result is consistent with the conclusions made by Longstaff (2004), Beber, Brandt, and Kavajecz (2009), and Goyenko and Ukhov (2009) for the US market. There are Granger causal relationships between illiquidity of the Russian stock and bond markets that confirms the presence of illiquidity spillovers in the Russian market. This result corroborates with the patterns present in developed markets studied by Chorida, Sarkar, and Subrahmanyam (2005), Fleming, Kirby and Ostdiek (1998), Ho and Stoll (1993), O'Hara and Oldfield (1996), Goyenko and Ukhov (2009).

The correlation analysis shows that an increase in the number of internet queries may serve as an indicator of higher volatility and illiquidity in the Russian stock market in the future. GOOGLE\_MICEX time series is a powerful forecasting indicator for stock market liquidity and volatility time series. Its share in

**Table 5.4.6.** Forecast Error Variance Decomposition for VAR Model for Monthly Data.



Source: Own calculation based on the data retrieved from Google Trends, Bloomberg database, Yahoo!Finance, Bank of Russia, Federal Service of State Statistics.

market microstructure factors' variance explanation is relatively high, which is consistent with the fact that individuals account for approximately a half of all investors in MICEX. The forecasts with a help of internet queries' tool should be adjusted in accordance with the proportions of each factor explained as suggested by weekly VAR model results. The results are consistent with the models' output for Western financial markets presented by Da *et al.* (2011), Dziełinski (2011), Dimpfl and Jank (2011) as well as Arouri *et al.* (2013). It is necessary to emphasize that the global factors, macroeconomic policy actions and indicators play a significant role in the Russian market. What follows, Google Trends may be used for financial analysis only in combination with other tools.

The stock and short term bonds illiquidity experience Granger causal relationship with the change in MIBOR. This conclusion differs from the results received by Naes, Skjeltop and Odegaard (2011), who show that illiquidity indicators are useful for the economic growth forecasting in the USA and Norway. Short term bonds' volatility is a leading indicator for industrial production change. It experiences a mutual Granger causality with MIBOR as well as for short term bonds' return that is a leading indicator for inflation. Stock market return experiences mutual Granger causality with inflation and MIBOR change, and stock market volatility is Granger caused by the change in industrial production. The quality of VAR model with the participation of macroeconomic variables supports the fact that the latter help to forecast market microstructure variables.

### 6.1 SUMMARY OF FINDINGS

The most important implication of the study is that it was empirically shown that Google Trends, particularly the queries in English language, may be effectively used for forecasting the Russian market microstructure indicators. Another important conclusion is that the Russian market still remains structurally unstable, and the results of the models are highly sensitive to model specification and data frequency, especially when the market microstructure is analyzed. The forecasting power of different assets' liquidity, volatility and return factors varies significantly. The behavior of market microstructure parameters in the Russian market differs from those in Western markets. In addition, the influence of the global factors, macroeconomic indicators, monetary policy actions as well as market microstructure parameters on microstructure features of stocks and bonds of different maturities in the Russian market is not the same. Therefore, this study emphasizes that in the contemporary environment the analysts cannot rely only on one tool when making their fore-

casts. Obviously, the spillover effects from the global markets, the economic policy as well as the individual assets characteristics should be included in the analysis. Finally, internet queries may serve as a proxy of public behavior suitable for the highly volatile and unstable markets' financial analysis. The increasing availability of big data sets offers an exciting possibility to study the collective behavior of the Russian investors and the society in general.

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# The Routes to Chaos in the Bitcoins Market\*

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**Abstract.** I argue that the bitcoins market is an example of a complex system without a stable equilibrium. The users of bitcoins fall into two broad categories: 1) Capital gain seekers: who have no functional use for the currency apart from an expectation of capital gains; 2) Functional users: who use the currency to save on transaction costs as it provides a less costly medium of exchange over traditional fiat currencies. I assume that each category consists of mean-variance optimizers, and specify simple evolutionary dynamics for each category. I identify two simple routes to chaos in the bitcoins market. If only capital gain seekers are present, then one route to chaos is via the logistic map. If both categories of users matter then a possible route to chaos is via the delay logistic-Hénon map. A policy recommendation follows: in order to pre-empt chaos in the bitcoins market, currency exchanges should be allowed to convert bitcoins into dollars and vice versa if and only if there is an associated transaction involving buying and selling of goods or services or if the bitcoins are freshly mined. Such a regulation pre-empts chaos by reducing the impact of capital gain seekers on the virtual currency's value.

**Аннотация.** Рынок биткоинов является примером сложной системы, не имеющей устойчивого равновесия. Пользователи биткоинов делятся на две большие категории: 1) стремящиеся только к приросту капитала; 2) функциональные пользователи, которые используют валюту, чтобы сэкономить на транзакционных издержках. Я определяю два пути, которые могут привести к хаосу на рынке биткоинов. Если присутствуют только искатели прироста капитала, то маршрут к хаосу идет через логистическое отображение. Если обе категории пользователей присутствуют, то маршрут к хаосу возможен с помощью отсроченного логистического отображения Эно. Вывод: чтобы не допустить хаос на рынке биткоинов, валютным биржам следует разрешить конвертацию биткоинов в доллары и наоборот, только если имеется связанная сделка покупки или продажи товаров или услуг, или если биткоины только что получены. Такое регулирование предотвращает хаос путем уменьшения воздействия на стоимость виртуальной валюты со стороны пользователей, ищущих прироста капитала.

**Key words:** Bitcoins, chaos, speculation, digital currency, complex system, mean-variance optimization, medium of exchange, store of value, logistic map, delay logistic-Hénon map.

## 1. INTRODUCTION

Bitcoins is a decentralized virtual currency that emerged privately in 2009 with an objective of providing a low cost medium of exchange to facilitate transactions (locally as well as internationally). Financial institutions that facilitate transactions with government backed currencies need to invest heavily in infrastructure to be able to serve as effective facilitators of transactions. These infrastructural costs are passed on to merchants and customers in various forms such as credit card fees, wire transfer charges etc. The virtual currency bypasses this expensive infrastructure by utilizing the power of the bitcoin network based on peer to peer technology. Hence, it offers significant cost advantages as a medium of exchange. However, the virtual currency has no basis to

be a reasonably reliable store of value (as elaborated in Quiggin (2013), Krugman<sup>1</sup>, DeLong<sup>2</sup>, and others, it has no base-line intrinsic value as it cannot be used to pay off tax obligations).

The inability to be a reasonably reliable store of value has implications for the currency's effectiveness as a medium of exchange. An example clarifies: Suppose you are a merchant in the business of selling computers and you have been made aware of the significant cost advantages that would accrue to you if you start accepting bitcoins in exchange for computers. The system works as follows: When a customer buys a computer from you, you will send the bill to an online currency exchange. The online exchange will convert the total from dollars into bitcoins, and

<sup>1</sup> Bitcoin is Evil. Available at <http://krugman.blogs.nytimes.com>

<sup>2</sup> Watching Bitcoin, Dogecoin, Etc... Available at <http://equitablegrowth.org>.

\* Пути к хаосу на рынке биткоинов.



a scanbar known as QR will be generated. The customer, upon receiving this request (via an app on his phone), will approve it and funds will move from his digital wallet to your digital wallet within seconds. On the positive side, you stand to save thousands of dollars per annum in credit card fees. However, on the negative side, your main concern is the following: How many dollars will I get when I convert bitcoins received through sales into dollars? To answer this question, you need to form an expectation about the exchange rate in the future when you intend to convert bitcoins into dollars. How do you even begin to form such an expectation? This challenge is reminiscent of Keynesian beauty contest in which one is required to form an expectation about what average opinion expects average opinion to be and so on.

It is useful to compare bitcoins with any other financial asset such as a share of a firm. There are two main differences: 1) A share of a firm is a claim on the earning stream generated by the activities of the firm. As a shareholder, your claim on the earnings generated by the firm is independent of whether you are a short-term investor interested in capital gains only or a long term investor interested in the dividend stream. In the case of shares, even if you are primarily a capital gain seeker, you collect dividends accruing to you while you hold the shares. In contrast, the benefits from bitcoins are directly dependent on how you intend to use them. If you are a *functional user*, like the merchant in the example above, you save on transaction costs. However, if you are a *capital gains seeker* with no functional use for the currency, then you do not benefit in terms of transaction costs. You are just hoping to buy it cheap and sell it expensive. 2) The benefit stream to functional users is directly dependent on how many functional users of the currency are there. Of course, if a lot of people are using bitcoins then more transactions will happen with the virtual currency, generating more savings for merchants accepting bitcoins. In contrast, the benefit stream to shareholders has no such direct dependence on the number of shareholders. The *real* earning stream associated with a given firm's productive activities is not directly dependent on the number of shareholders it has.

In this article, I argue that the differences pointed out above imply that the bitcoins market is best thought of as a complex system without a stable equilibrium. Like any complex system, the bitcoins market is also characterized by both the positive and the negative feedback mechanisms. There is positive feedback because greater the acceptability of the currency (as evidenced by the number of users), stronger is the incentive for outsiders to join in. There is negative feedback because a capital gain seeker wants to realize

profits before other capital gain seekers do. I show that the interaction of the positive and negative feedbacks generates routes to chaos. This paper adds to a large and growing literature on nonlinear dynamics and chaos in economics; see Orlando (2006) for a survey. An incomplete list of papers exploring the emergence of chaos in economic systems includes Brock and Sayer (1988), DeCoster and Mitchell (1991), Holyst (1996), Kopel (1997), and Kaas (1998) among many others.

Of course, expectations regarding the future value affect the values of all financial assets, however, for share price, there is an associated earning stream generated by the productive activities of the firm, which exists out there independent of the number of shareholders. In theory, it is possible to form objective expectations about the *real* earnings stream. Rational expectations finance postulates that it is possible to express such expectations in terms of known exogenous factors; hence, somewhat ironically, expectations do not matter in rational expectations equilibrium as they are anchored in objectively known exogenous factors. In contrast, in the bitcoins market, it is impossible to express expectations solely in terms of exogenously known factors as the associated benefit stream is not available to capital gains seekers, and even for functional users, who have access to it, the benefit stream is endogenously generated through mutual use. Clearly, one can see the signs of a complex system in which expectations collectively generate an outcome, which in turn causes these expectations to be revised, which changes the outcome and so on, without ever settling down, as there is nothing to settle down to. For a discussion on complex systems thinking in economics, see Arthur (2013).

This article is organized as follows. Section 2 models the bitcoins market in a mean-variance optimization framework and argues that the market is a complex system without a stable equilibrium. A complex system may display extremely rich dynamics including sensitive dependence to initial conditions or chaos. A system in chaos can take completely unrelated paths even when the initial conditions are arbitrarily close. Section 3 specifies evolutionary dynamics under the assumption that only capital gains seekers exist and shows that there is a route to chaos via the logistic map. Section 4 specifies evolutionary dynamics under the assumption that both functional users and capital gains seekers matter and shows that there is a route to chaos via the delay logistic-Hénon map. Section 5 considers the case when only functional users are present and shows that equilibrium with rational expectations can be considered. Section 6 concludes with a discussion of a policy recommendation to pre-empt chaos in the bitcoins market.

## 2. THE BITCOINS MARKET AS A COMPLEX SYSTEM

Suppose there are two types of users of the bitcoins: 1) Functional users who primarily use the currency to save on transaction costs. Of course, they remain exposed to capital losses/gains on the virtual currency; 2) Capital gains seekers who have no functional use for the currency apart from an expectation of capital gains. That is, they hope to buy it cheap and sell it expensive.

Assume that there are only two assets: 1) Bitcoins and 2) A risk-free asset that pays  $(1 + r)$  for every dollar invested per period. That is, I assume that potential users of the currency can keep their wealth in dollars in which case, they earn the risk free rate, buy risky bitcoins, or hold any combination of bitcoins and dollars in accordance with their preferences. The wealth dynamics are given by:

$$W_{i(t+1)} = W_{it} (1 + r) + \check{R}_{i(t+1)} D_{it} \tag{1}$$

In (1),  $W_{it}$  is the total wealth of user  $i$  at time  $t$ .  $D_{it}$  is the number of units of bitcoins in possession of user  $i$  at time  $t$ .  $\check{R}_{i(t+1)}$  is the random excess return over the risk-free asset per unit of the virtual currency accruing to investor  $i$  in one period. That is:

$$\check{R}_{i(t+1)} = \check{B}_{i(t+1)} + \check{P}_{t+1} - (1 + r) P_t \tag{2}$$

Where  $\check{B}_{i(t+1)}$  is the monetary value of transactional advantage accruing to a functional user  $i$  of the virtual currency per period. Note,  $\check{B}_{i(t+1)} = 0$ , for capital gain seekers. That is, for capital gain seekers:

$$\check{R}_{i(t+1)} = \check{P}_{t+1} - (1 + r) P_t \tag{3}$$

Assuming all users are mean variance optimizers, the demand for bitcoins by user  $i$  can be obtained as follows:

$$\begin{aligned} & \text{Max}_{D_{it}} \left\{ E_{it} [W_{i(t+1)}] - \frac{e}{2} V_{it} [W_{i(t+1)}] \right\} \\ & \Rightarrow D_{it} = \frac{E_{it} [\check{R}_{i(t+1)}]}{e V_{it} [\check{R}_{i(t+1)}]} \end{aligned} \tag{4}$$

Where  $E_i$  and  $V_i$  are conditional expectation and variance operators respectively, and  $e$  is the risk aversion parameter. Equation (4) shows that the demand for bitcoins by user  $i$  is equal to the expected excess benefit of bitcoins over dollars, scaled down by risk aversion multiplied by conditional volatility.

The supply of bitcoins follows a known schedule as new bitcoins are generated and awarded to people called miners if they solve complex algorithms of increasing difficulty. I denote the total supply of bitcoins at time  $t$  by  $W_{it}$ .

The market price of bitcoins can be obtained by equating the total demand to total supply:

$$\sum_{f=1}^{F_t} D_{ft} + \sum_{c=1}^{C_t} D_{ct} = m_t \tag{5}$$

Where  $f$  and  $c$  are indices for functional users and capital gain seekers respectively.  $F_t$  is the total number of functional users at time  $t$ , and  $C_t$  is the total number of capital gain seekers at time  $t$ .  $F_t$  and  $C_t$  are evolving over time as more and more people are becoming aware of it with time. In the next two sections, I discuss two ways in which chaotic dynamics can arise in the evolution of  $F_t$  and  $C_t$ .

Define the total number of demanders at time  $t$  as follows:  $N_t = C_t + F_t$ . For simplicity, assume that the conditional volatility is the same for every user, and all users have the same coefficient of risk aversion.

From equation (5), it follows:

$$\frac{1}{N_t (1 + r)} \left\{ \sum_{f=1}^{F_t} E_f [\check{B}_{f(t+1)}] + \sum_{f=1}^{F_t} E_f [\check{P}_{t+1}] + \sum_{c=1}^{C_t} E_c [\check{P}_{t+1}] - m_t e V \right\} = P_t \tag{6}$$

In (6), each user forms an expectation about the price next period.

To appreciate the complexity of the situation, consider a functional users expectation about the price next period:

$$E_f \left[ \frac{1}{N_{t+1}(1+r)} \left\{ \sum_{f=1}^{F_{t+1}} E_f [\tilde{B}_{f(t+2)}] + \sum_{f=1}^{F_{t+1}} E_f [\tilde{P}_{t+2}] + \sum_{c=1}^{C_{t+1}} E_c [\tilde{P}_{t+2}] - m_{t+1} eV \right\} \right] = E_f [P_{t+1}] \quad (7)$$

So, a functional user's expectation about the price next period depends on his expectation of other users' expectations about the price in the next to next period. Trying to find out the expectation about the price in the next to next period leads to expectations about expectations about expectation. Clearly, one can continue this to obtain an infinite regress of expectations about expectations. This issue in financial markets led Keynes (1936) to form an analogy with a fictional newspaper beauty contest in which the contestants are asked to choose from among the set of six photographs of women. Those who choose the most popular one are declared winners.

*"It is not a case of choosing those [faces] that, to the best of one's judgment, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees."* (Keynes, *General Theory of Employment Interest and Money*, 1936).

Rational expectations finance found a way to work around this problem by postulating that agents hold (rational) expectations which are consistent with observable outcomes. This requirement imposes a very strong condition on allowable expectations as it eliminates expectational heterogeneity. In theory, one can make a case for rational expectations when it comes to share prices as shares are claims on earning streams that exist largely independent of shareholders. As earning streams of firms have a reality independent of shareholders, wrong expectations can be corrected through negative feedback, and in theory, a stable equilibrium may exist. However, there is difficulty in accepting this line of thinking as one clearly sees heterogeneous expectations in financial markets.

If the idea of rational expectations is hard to swallow for the relatively stable stock markets, this notion seems largely irrelevant in the bitcoins market. In the bitcoins market, the benefit stream, which is only available to functional users, not only varies from person to person, but is directly dependent on the number of functional users. That is, the benefit stream is endogenously generated. Even if we impose expectational homogeneity on functional users, there are capital gain seekers who do not get any functional benefits. They are simply hoping to buy cheap and sell expensive.

It is useful to think of the bitcoins market a complex system with both positive and negative feedbacks. Existence of both kinds of feedbacks is the defining feature of complex systems. See Arthur (2013) for a discussion on this kind of thinking in economics.

There is positive feedback for two reasons: 1) Greater the number of functional users, higher is the expected functional benefit, so addition of more functional users creates incentives for more functional users to join in. 2) Greater the number of users of the virtual currency, faster is the word of mouth influence, which has been the best advertisement for the currency.

There is negative feedback for the following reasons: 1) Greater the number of capital gain seekers, higher is the chance that profit taking would depress the price next period. 2) Functional users are also aware of the possibility of profit taking by capital gain seekers; hence, they may also adjust their demand downwards in anticipation of a decline.

In the next section, I discuss the implications of the positive and negative feedbacks for price dynamics in the bitcoins market.

### 3. BITCOINS MARKET: THE SIMPLE CASE

It is useful to discuss the simple case first, in which, there are no functional users. That is, only capital gain seekers are present. The price dynamics are then described by the following equation:

$$\frac{1}{C_t(1+r)} \left\{ \sum_{c=1}^{C_t} E_c [\tilde{P}_{t+1}] - m_t eV \right\} = P_t \quad (8)$$

To simplify matters further, I assume that short selling is not allowed. A capital gain seeker has a positive demand for bitcoins at price  $P_t$  if the following holds:

$$E_c[\tilde{P}_{t+1}] > P_t(1+r) \tag{9}$$

Note, that inequality (9) holds for all capital gain seekers who invest in bitcoins at time  $t$ . It follows:

$$E_c[\tilde{P}_{t+1}] = P_t(1+r) + f_c(P_t) \tag{10}$$

Where  $f_c$  is individual specific and a decreasing function of  $P_t$ . At the market clearing price,  $f_c(P_t)$  is zero for the marginal capital gain seeker.

Substituting (10) in (8):

$$\frac{1}{C_t(1+r)} \left\{ C_t P_t(1+r) + \sum_{c=1}^{C_t} f_c(P_t) - m_t eV \right\} = P_t \tag{11}$$

$$\Rightarrow \sum_{c=1}^{C_t} f_c(P_t) = m_t eV \tag{12}$$

It is clear from equation (12) that the dynamics of  $C_t$  are the key to understanding the price dynamics in the bitcoins market.

The bitcoins market can be thought of as a complex system in which both positive and negative feedbacks influence  $C_t$ . As awareness of bitcoins is spreading through word of mouth, one may consider the following for positive feedback:  $aC_{t-1}$  where  $a$  is a positive constant, and  $C_{t-1}$  is the number of capital gain seekers with positive demand at time  $t-1$ . There is also negative feedback, as the sole objective of a capital gain seeker is to realize capital gains before the bubble bursts. So, the presence of other capital gain seekers also makes a given capital gain seeker wary as he wants to realize capital gains before they decide to do so, as that would depress the price. In short, greater the number of capital gain seekers, bigger is the bubble. The bigger the bubble, stronger is the chance of it bursting in the next period. I postulate that the probability that a given capital gain seeker would realize capital gains by selling is proportional to the total number of capital gain seekers in the market at a given point in time. Introducing a constant of proportionality  $b$ , one may reason that the probability that a given capital gain seeker would realize profits is:  $bC_{t-1}$ . Hence, the expected number of users who realize capital gains is:  $bC_{t-1}^2$ . Combining the positive and negative feedbacks, one may write:

$$C_t = aC_{t-1} - bC_{t-1}^2 \tag{13}$$

One can study the qualitative dynamics for various values of the parameters.

Substitute (13) in (12):

$$\Rightarrow \sum_{c=1}^{aC_{t-1} - bC_{t-1}^2} f_c(P_t) = m_t eV \tag{14}$$

It is clear from equation (14) that the dynamics of (13) are the key to understanding the dynamics of (14). (13) can be transformed into the famous logistic equation with a simple change of variables as follows:

$$C_t = aC_{t-1} \left( 1 - \frac{b}{a} C_{t-1} \right)$$

$$\text{Define } x_{t-1} = \frac{b}{a} C_{t-1}$$

$$x_t = ax_{t-1}(1 - x_{t-1}) \tag{15}$$

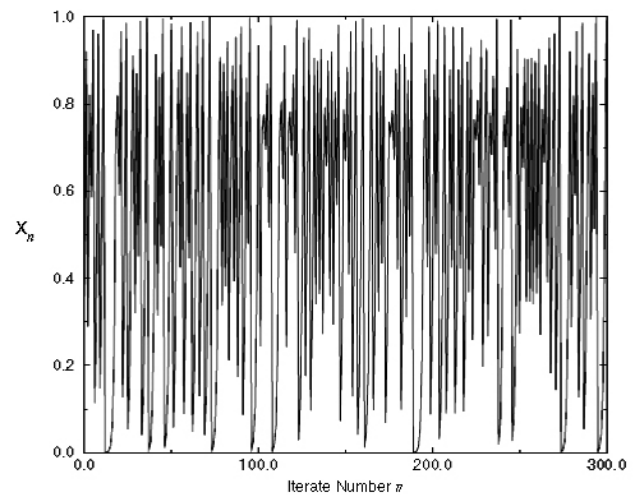


Figure 1. The behavior of logistic map when  $a = 4$ .

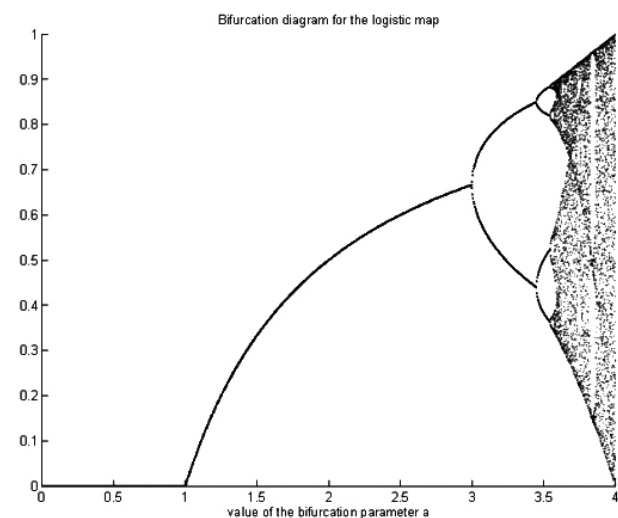


Figure 2. As Figure 2 shows, the logistic map has interesting dynamics including emergence of chaos beyond a certain threshold (approximately beyond  $a = 3.8$ ).

(15) is the famous logistic map, which has been extensively studied in nonlinear dynamics and chaos literature over the past 25 years. A recent reference is Groff (2013). chaos, or sensitive dependence on initial conditions, arises in the logistic map if the value of exceeds a certain threshold. Figure 1 shows one path when  $a = 4$ .

The behavior of the logistic map can be summarized for various values of ‘a’ as a bifurcation diagram with a period doubling route to chaos as Figure 2 shows.

#### 4. BITCOINS MARKET: THE GENERAL CASE

If both the functional users and the capital gain seekers are present, then the price dynamics are described by (6) which is re-produced below:

$$\frac{1}{N_t(1+r)} \left\{ \sum_{f=1}^{F_t} E_f [\tilde{B}_{f(t+1)}] + \sum_{f=1}^{F_t} E_f [\tilde{P}_{t+1}] + \sum_{c=1}^{C_t} E_c [\tilde{P}_{t+1}] - m_t eV \right\} = P_t \tag{16}$$

For simplicity, and without loss of generality, I assume that all functional users form identical expectations. That is:

$$\frac{1}{N_t(1+r)} \left\{ F_t (E_f [\tilde{B}_{t+1}] + E_f [\tilde{P}_{t+1}]) + \sum_{c=1}^{C_t} E_c [\tilde{P}_{t+1}] - m_t eV \right\} = P_t \tag{17}$$

Next, I specify the dynamics of  $F_t$  and  $C_t$ .

The dynamics of  $C_t$  are identical to the one described in the previous section except that now the word of mouth influence has been supplemented due to the presence of functional users:

$$C_t = a(C_{t-1} + F_{t-1}) - bC_{t-1}^2 \tag{18}$$

To specify the dynamics of functional users, one needs to consider that they are wary that the bubble created by capital gain seekers may burst causing capital losses to them. As before, bigger the bubble, greater is the chance of it bursting in the next period. Size of the bubble is proportional to the number of capital gain seekers in the market. Hence, one may argue that the probability of a functional user exiting the market in anticipation of an imminent capital loss as proportional to  $C_{t-1}$ . Introducing a constant of proportionality,, one may write the probability as  $hC_{t-1}$ . That is, the expected number of functional users exiting the market due to anticipated imminent capital losses is given by  $hC_{t-1} F_{t-1}$ . The dynamics of functional users can then by summarized as:

$$F_t = l(C_{t-1} + F_{t-1}) - hC_{t-1} F_{t-1} \tag{19}$$

Where  $l$  captures the strength of word of mouth influence on functional users.

To simplify matters further, one may write:

$$F_t = l(C_{t-1} + F_{t-1}) - hC_{t-1} F_{t-1} \sim qC_{t-1} \tag{20}$$

So,

$$F_{t-1} \sim qC_{t-2} \tag{21}$$

Substituting (21) in (18):

$$C_t = a(C_{t-1} + qC_{t-2}) - bC_{t-1}^2 \tag{22}$$

$$\Rightarrow C_t = aC_{t-1} + aqC_{t-2} - bC_{t-1}^2 \tag{23}$$

Carry out the following variable transformation:  $x_{t-1} = \frac{b}{a} C_{t-1}$ .

$$\Rightarrow x_t = ax_{t-1}(1 - x_{t-1}) + aqx_{t-2} \tag{24}$$

(24) is a delay logistic-Hénon map in which chaos arises. See Skiadas and Skiadas (2008) for details of the associated chaotic attractor.

## 5. DISCUSSIONS AND CONCLUSIONS

Even though the chosen dynamics are that of logistic and delay logistic-Hénon maps, the emergence of chaos is a general property of nonlinear maps. One can choose different dynamics and chaos is still likely to arise as long as the resulting map is nonlinear. The source of nonlinearity is the presence of capital gain seekers. For this reason, it seems that chaos is likely to arise in the bitcoins market.

One way to pre-empt chaos is to limit the role of purely capital gain seekers in the market. I suggest that a regulation be put in place to this effect. One possibility is to constrain online exchanges to convert bitcoins into dollars and vice versa if and only if there is an associated transaction involving goods and services or if the bitcoins are freshly mined. Even if the capital gain seekers are no longer present, the currency will still be quite volatile as the functional benefits are endogenously generated through mutual use and vary from user to user. However, if the currency gains greater acceptability, the average value of discounted expected benefits from its functional use (transaction cost savings over traditional fiat currencies) may form an anchor for expectations, enabling the possible emergence of a stable equilibrium. This may happen as the routes to chaos would be blocked as, without capital gain seekers, nonlinearity disappears. Finally, I would like to point out that this paper abstracts away from the law enforcement challenges arising from the use of bitcoins and other virtual currencies. See Trautman

(2014) for a discussion of associated law enforcement challenges.

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# Exchange Rate Modeling: The Case of Ruble\*

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**Abstract.** The model of the equilibrium exchange rate of ruble is under construction on the basis of streams of the balance of payments of Russia taking into account trade conditions. Export-import transactions, factors of movement of the capital, trade condition, indexes of the internal and export prices, real gross domestic product, factors of elasticity of the foreign trade operations, decisions of microagents are used as base determinants in the model. In the process of creating the model a number of key internal dynamic functional dependencies were found that allowed to put the capital flows in the model on formal logical level, and, thus, to extend the model to the case of capital mobility. We discuss the relationship results from the fundamental equilibrium exchange rate in the framework of the author's conceptual approach to the assessment of the equilibrium exchange rate based on international flows (IFEER). The technique of adjustment of model internal parameters is offered with a view of macroeconomic regulation of the exchange rate of ruble. Based on the modeling results we built the analysis of the dynamics of the nominal exchange rate of ruble in 2013–2015.

**Аннотация.** Модель равновесного валютного курса рубля строится на основе движения средств по счетам платежного баланса России с учетом условий торговли. В качестве базовых детерминант в модели используются экспортно-импортные операции, факторы движения капитала, условия торговли, индексы внутренних и экспортных цен и реального ВВП, коэффициенты эластичности внешнеторговых операций, межвременные решения микроагентов. В процессе создания модели был обоснован ряд ключевых внутренних динамических функциональных зависимостей модели, что позволило включить на формально-логическом уровне потоки капитала в модель и таким образом расширить модель на случай мобильности капитала. Обсуждается связь результатов с фундаментальным равновесным курсом в рамках разработанного авторского концептуального подхода к оценке равновесного валютного курса на основе международных потоков (IFEER). В результате была выведена многофакторная формула динамики валютного курса рубля. Предлагается методика настройки внутренних параметров модели в целях макроэкономического регулирования курса. На основе результатов моделирования проведен анализ динамики номинального курса рубля в 2013–2015 гг.

**Key words:** Equilibrium exchange rate, exchange rate of ruble, balance of payments, trade condition, macroeconomic policy, capital streams.

Conceptual approaches to modeling the dynamics of the exchange rate of the national currency have fluctuated in recent years widely. One of the first studies that can be considered a model was by Y. Lukashin and A. Lushin (1994) of the formation of the exchange rate USD/RUR on MICEX. In the framework of the classical pricing model of P. Samuelson based on current supply and demand, the authors statistically modeled the exchange rate of the ruble. However, the short-term nature and the lack of analytical explanation of the genesis of monetary flows restrict the use of the model. Later model of A. Pervozvansky (1998) was applicable in the medium and long term, but had one significant drawback: it was based on the theory of purchasing power parity (in its non-equilibrium

interpretation). And here it should be emphasized that the concept of purchasing power parity fails in general at least in the medium term, as shown in the author's works (Kuzmin, 2014a, 2010b).

There were carried out some parallel researches of the factor systems determining the exchange rate. In particular, the concept specific efficiency of foreign trade operations has been successfully applied to study of the equilibrium dynamics of ruble by L. Strizhkova and others (2001). A multifactor model of exchange rate dynamics of ruble was developed by the author in 1998–99 (Kuzmin, 1999). Also research of S. Dubovsky (2002) was based on the optimization problem, the results of which were applied to the analysis of the behavior of the ruble during 1996–1999.

\* Моделирование курса рубля.

Further simulation of currency pricing on the basis of supply and demand was found in the model proposed by A. Kugaenko (2005). A number of issues of modeling of exchange rate dynamics in modern conditions were studied by M. Dmitrieva and S. Suetin (2012), by B. Putko, A. Didenko, M. Dubovikov (2014). However, to construct a mathematical model of the ruble in the medium term further developments are necessary based on the study of the movement of funds on accounts of the balance of payments of Russia and taking into account the terms of trade as the most important determinants.

Thus, along with the importance of conducting long-term analysis of the behavior of the exchange rate of ruble (e.g., the author's work: Kuzmin, 2014b, 2010a), greatly increases the need to study the medium-term equilibrium dynamics of the ruble and its fundamental determinants.

The model of dynamics of the equilibrium exchange rate of ruble proposed in this paper is a development of previous research of the author and takes into account the medium-term period, the terms of trade, flow of funds of the balance of payments, including export-import operations and, in part, capital flows with the preferences of investors. Thus, this exchange rate balances the balance of payments and, as a consequence, the demand and supply of currency on the monetary market. The main objective of the model is to identify the dependence of the dynamics of the exchange rate of ruble from the consumer price indices and export price and real GDP. During the construction of the model the other factors were eliminated.

This approach has been used consistently by the author (Kuzmin, 2014a, 2014b, 2011, 2010b, 1999) and in the context of this work it would be productive. It is also supported by other researchers: for example, L. Krasavina: "To improve the effectiveness of exchange rate policy, in our view, it is necessary: — to use the technique of determining the exchange rate of ruble on the basis of multifactor but not unifactor concept, mainly taking into account the dynamics of oil prices... — when forecasting the exchange rate, on the basis of the balance of payments, it is advisable to consider not only the current account, but the account of the international movement of capital and financial instruments, whose role have increased in conditions of financial globalization" (Krasavina, 2014).

## BASIC ASSUMPTIONS OF THE MODEL

For analysis of the ruble it is necessary to highlight the characteristics of the Russian currency market, used in further constructions:

- The mode of conducting monetary policy is a managed float of the national currency ("too controlled", according to opinion of many economists),
- There are no serious restrictions on current account transactions (which corresponds to Art.VIII of the IMF Charter),
- There are restrictions on settlements between residents in foreign currency,
- The quality and the cost of currency exchange services comply with the global standards.

One must first consider several exchange rates existing in the country:

- Centrally set rate (the rate of the Central Bank of Russia),
- The rate of interbank market,
- The rate of the currency exchanges,
- The exchange rate of foreign banknotes.

The choice of synthetic value, which continues to be the exchange rate directly depends on the magnitude of mismatch between each of above-mentioned rates.

This choice has the following advantages:

- As a rule, the rate of the interbank market slightly deviates from a centrally set rate,
- In case of legal prohibition or restriction of settlements between residents in foreign currency interbank market is the only source of market calculations and the rate of sale and purchase by customers at banks currency differs from the interbank quotations on the value of the bank's commission. In this case, the interbank market becomes a kind of intermediary, accumulating and satisfying the requests of all participants in foreign exchange trading,
- Constant presence of the Central Bank and the possibility of currency interventions consistent with the internationally accepted standards of market regulation,
- In many cases, the interbank rate slightly deviates from the rates of currency exchanges because of the ease of spatial arbitrage and high degree of interconnectedness of these segments of the currency market,
- The exchange rate of foreign banknotes directly determined by the interbank rate, with the "cost principle: the interbank rate plus the cost of cashing out".

For medium-term studies of the equilibrium dynamics of exchange rate of ruble it is possible to apply the principles of modeling of the international flows equilibrium exchange rate (IFEER), developed in the aforementioned works of the author. Even more revealing must be the comparison of the approaches and results of assessments that identify the exchange rate mechanism on the basis of economic-mathematical modeling of crisis processes.



To study the dynamics of the ruble (and also other currencies with varying degrees of floating we propose a definition of the exchange rate  $e$  as the average weighted on volumes of foreign currency value rate  $N$  market transactions  $e_i, i \in (1, N)$  for a certain period of time. The earlier result (Kuzmin, 2014a, 2014b) of a conceptual level shows that the exchange rate  $e_t$  is equal to the aggregate amount of funds in national currency divided by the aggregate amount of funds in foreign currency traded on the foreign exchange market during a given period  $t$ . Briefly, after disaggregating flows resulting dynamic dependence has the form that is the basic result for further analysis:

$$e_t = (I_t + K^-) / (E_t + K^+), \quad (1)$$

where  $I$  is the demand in the national currency on foreign imports,  $E$  is the offer of foreign currency from exports,  $K^-, K^+$  – respectively, the amount of capital outflow (demand in national currency in foreign) and capital inflow (the supply of foreign currency).

### THE USE OF INDICATORS OF FOREIGN TRADE OPERATIONS AND THE TERMS OF TRADE WHEN ASSESSING EXCHANGE RATE

Further, at this stage, we make a few assumptions:

1. The Central Bank conducts strict regulation of capital movement restrictions, or completely satisfies the demand for foreign currency on the accounts of capital movements, depending on the situation, domestic or foreign, by sale or purchase due to changes in foreign exchange reserves. Then in the numerator and denominator of dependence (1) two last members are eliminated.

2. The current account consists of the operations of export-import of goods and services and does not account the unilateral transfers.

3. The country has only one trading partner, represented as the rest of the world.

Then (1) can be represented as

$$e = I / E.$$

Let us consider a two-period case model in times  $t, t-1$ . Let the resident direct consumption imports of goods and services at time  $t$  with proportion of their income, represented not only current income, but also income in the previous time. Assume that this function is as follows

$$I_t = k_1 P_t Q_{t-1}^{1/3} Q_t^{2/3}, \quad (2)$$

where  $k_1 = const$ ,  $Q_t$  – index of real total output (e.g., real GDP),  $P_t$  – the internal prices index (e.g., consumer), and the indices  $t, t-1$  indicate, respectively, the beginning and the end of the period. Method of averaging of income should not have a significant influence on the final result due to the insignificance of fluctuations in the variable  $Q$  in the medium term compared to possible changes in other macroeconomic indexes.

In the conditions of Russia's further integration into the world economy and WTO membership it is the expansion of Russia's participation in world trade. And here it should be emphasized that the dynamics of commodity exports largely determines the country's economic growth, as shown by several authors (e.g. Ershov, 2014; Kuzmin, 2014b; Krasavina, 2014). Amount of currency brought to the domestic market at time  $t$  is determined by the physical volume of exports, which depends on the terms of trade, presents a near real exchange rate value as follows

$$e^R_{t-1} = e_{t-1} \frac{P_{t-1}^*}{P_{t-1}},$$

and is determined by the decisions of producers-exporters at time  $t-1$ . Where  $P_{t-1}^*$  – export price index. The impact of real exchange rate on exports is recorded in several of the above-mentioned works.

Then the dollar amount of currency price  $E$  at time  $t$ , which came on the domestic foreign exchange market as revenue exports of goods and services, will be equal to

$$E_t = P_t^* k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\delta} \sqrt{e_{t-1}^R} = P_t^* k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\delta} \sqrt{e_{t-1} \frac{P_{t-1}^*}{P_{t-1}}}. \quad (3)$$

The part  $k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\delta}$  reflects the fact that the physical export is part of total output, which is averaged for the reasons given above. Non-negative rate shows a "slightly larger" growth of exports compared to imports as a function of total output that occurs because of limited domestic demand and, thus, the need for a growing portion of total output to sell at the expense of exports.

From (1), (2), (3):

$$\begin{aligned} e_t = I_t / E_t &= \frac{k_I P_t (Q_{t-1}^{1/3} Q_t^{2/3})}{P_t^* k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\delta} \sqrt{e_{t-1} \frac{P_{t-1}^*}{P_{t-1}}}} = \\ &= k_I / k_E \frac{P_t Q_t^{-2/3\delta}}{P_t^*} \sqrt{\frac{P_{t-1} Q_{t-1}^{-2/3\delta}}{P_{t-1}^*}} \frac{1}{\sqrt{e_{t-1}}}. \end{aligned}$$

If  $k = \sqrt[3]{k_I / k_E}$  we can rewrite this in the form:

$$e_t \sqrt{e_{t-1}} = k^2 \frac{P_t Q_t^{-2/3\delta}}{P_t^*} \sqrt{k^2 \frac{P_{t-1} Q_{t-1}^{-2/3\delta}}{P_{t-1}^*}}.$$

Hence, we obtain, after a temporary separation of variables:

$$\begin{aligned} e_t &= k^2 \frac{P_t Q_t^{-2/3\delta}}{P_t^*} \\ e_{t-1} &= k^2 \frac{P_{t-1} Q_{t-1}^{-2/3\delta}}{P_{t-1}^*}. \end{aligned}$$

Extending the model to multi-period case, we get the following dynamic multifactor dependence of exchange rate of ruble from the real aggregate output and price levels in the country and abroad:

$$e(t, Q(t), P(t), P^*(t)) = e_t(CA) = k^2 \frac{P_t}{P_t^*} Q_t^{-2/3\delta}. \quad (4)$$

Thus, under perfect regulation of the movement of capital by Central Bank of Russia, the main determinants of the movement of exchange rate of ruble are the consumer price index and the price index of exports.

Basic formula (1) in an expanded form was studied by Strizhkova, Yermolayeva and others (2001) based on quarterly data from Q1 1995 to Q1 2001:

$$e_t = \alpha + \sigma I_t / E_t,$$

where  $\alpha, \sigma$  — the settings for the econometric model. The calculations showed satisfactory suitability of the model.

## THE INCLUSION OF CAPITAL FLOWS IN THE MODEL

The inflow and outflow of capital into the country are one of the most important factors in the behavior of the exchange rate of the ruble and, along with other components should have an impact on the result of the formula (1).

In advanced econometric models (Strizhkova, Yermolayeva and others, 2001) have also been investigated flows on accounts of the balance of payments and their impact on the dynamics of the ruble nominal exchange rate in the form:

$$e_t = \alpha + \sigma(I_t + \sum_{i=1}^5 C_{it}) / (E_t - Z_t),$$

where  $Z_t$  is the change in the outstanding import advances and in lost export revenue,  $C_{1t}$  – net errors and omissions,  $C_{2t}$  – the government debt service,  $C_{3t}$  – change in foreign assets of the banking system,  $C_{4t}$  – net increment of cash foreign currency,  $C_{5t}$  – change of the official foreign reserves of the Central Bank of Russia. Calculations based on this econometric model have helped to clarify previously obtained results of the authors, albeit marginally.

Generally speaking, the study of capital flows faced with a serious problem of the separation of medium- and short-term speculative components, specifically outlined by the IMF in 1984 and which is typical not only for Russia. In addition, the examination of the actual inflows and outflows of capital from Russia is complicated by significant mystery of the escape and return of capital across borders, and the imperfect statistics. However, this problem can get a permit in the framework of this model on the formal logical level through the adoption of several hypotheses about the dynamics of capital movements.

For the dependence of capital outflow we will accept here the hypothesis that it is part of a comprehensive income of microeconomic agents domestically displayed abroad for the purpose of savings:

$$K_t^- = k_{K^-} P_t (Q_{t-1}^{1/3} Q_t^{2/3}), \tag{5}$$

where  $k_{K^-} = const$ .

The inflow is a function, increasing on total real product (international investors and speculators want to buy a part in their prices for the above reasons) and the terms of trade. The last explanation lies in the fact that the fall of the national currency (respectively increase of the exchange rate) improves investment conditions for non-residents. This was also confirmed by studies on Japan and the United States and several other countries.

Based on this we will take the following hypothesis:

$$K_t^+ = k_{K^+} P_t^* (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\theta} \sqrt{e_{t-1}^R}. \tag{6}$$

where  $k_{K^+} = const, \theta > 0$ .

The increased inflow of capital to GDP growth is more than proportional (the indicator  $\theta$  in a member  $(Q_{t-1}^{1/3} Q_t^{2/3})^{1+\theta}$ ), in this case due to the following reasons:

- Due to the growth of the economy improves the investment climate,
- Realized and expected positive effect of import substitution;
- Investor's expectations of higher interest rates to keep the economy from overheating increase,
- Psychological mood of market participants improves.

Take also without restricting the generality that (5) and (6) consider the operations of the Central Bank of the Russian Federation.

Substituting in (1) formulas (2) – (6), we obtain

$$e_t = \frac{k_I P_t (Q_{t-1}^{1/3} Q_t^{2/3}) + k_{K^-} P_t (Q_{t-1}^{1/3} Q_t^{2/3})}{P_t^* k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\delta} \sqrt{e_{t-1} P_{t-1}^* / P_{t-1}} + P_t k_{K^+} (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\theta} \sqrt{e_{t-1} P_{t-1}^* / P_{t-1}}} = \frac{P_t (Q_{t-1}^{1/3} Q_t^{2/3}) (k_I + k_{K^-})}{P_t^* (Q_{t-1}^{1/3} Q_t^{2/3})^{1+\theta} \sqrt{e_{t-1} P_{t-1}^* / P_{t-1}} (k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{\delta-\theta} + k_{K^+})}. \tag{7}$$

Because by logic  $(\delta - \theta) \approx 0$  and reasonable stability of the member  $(Q_{t-1}^{1/3} Q_t^{2/3})$  compared to the rest settings of the model we will assume the following member in formula (7) as a constant:

$$\frac{(k_I + k_{K^-})}{(k_E (Q_{t-1}^{1/3} Q_t^{2/3})^{\delta-\theta} + k_{K^+})} = (k')^3 \approx const.$$

And  $k'$  is the more stable the smaller is the ratio  $(k_E / k_{k'})$  is, i.e. more capital flows compared with transactions on current balance.

Then (7) can be rewritten

$$e_i \sqrt{e_{i-1}} = \frac{k^{1/2} P_i Q_i^{-2/3^0}}{P_i^*} = \sqrt{\frac{k^{1/2} P_{i-1} Q_{i-1}^{-2/3^0}}{P_{i-1}^*}},$$

and by analogy with (4):

$$e(t, Q(t), P(t), P^*(t)) = e_i = k^{1/2} \frac{P_t}{P_t^*} Q_t^{-2/3^0} = k \frac{P_t}{P_t^*} Q_t^{-2/3^0}. \quad (8)$$

Comparative dynamics of functional dependencies (2), (3), (4), (8) was studied by the author in different works (Kuzmin, 2014c, 2011, 2010a, 2010b, 1999) in the periods 1997–99 and 2008–2009. As a result, the theoretically calculated indices show a good agreement with empirical observations of the dynamics. Possible deviations may be explained by the inaccuracy of the calculations (primarily index of export prices), within a month fluctuations in the rate, as well as a random component.

## SETTING UP THE INTERNAL MODEL COEFFICIENT

The choice of the starting point of the research period. As the starting point of the period to study the medium-term dynamics of the nominal exchange rate ruble we choose date, which meets the following criteria:

1. Stable finding the real exchange rate of ruble against the US dollar in the previous period.
2. Stable or moderately increasing reserves of the Central Bank of Russia in the previous period, indicating that the balance of payments is in the medium term equilibrium.
3. World prices for Russian exports correspond to the medium-term values.

Thus, for the purposes of this study as the starting point of the period to study the medium-term dynamics of the ruble was chosen December 2013.

**Main economic indicators – fundamental determinants of the model.** In the context of this paper, it is indicative that the subject matter of essential raw material component of Russian exports, which occupies about two thirds of total exports, underscores one of the basic macroeconomic indicators – the index of average actual export price  $P_i^*$ .

In the presented system the determinants of the exchange rate, as can be seen from (8), it directly determines (as the most volatile from economic position) short-term dynamics of exchange rate of ruble due to sufficient stability compared to other factors of the index of real aggregate output  $Q_i$  and the consumer price index  $P_i$ . The interested reader can also be recommended a slightly different view in the paper by V. Putko, A. Didenko, M. Dubovikov (2014) on the volatility of the exchange rate RUR/USD, when volatility unfolded into components characterizing the fractal structure of financial time series.

However, none of the famous Russian economic agencies (incl. Federal service of state statistics of Russia) does not calculate this index (export prices). Therefore, the first and one of the most time consuming tasks were the collection and processing of data on the subject. Due to sparseness and lack of information on quantitative indicators (indices of prices and the share in total exports of various commodity groups in retrospect) construction of a complete index of export prices was practically impossible. However, the analysis and selection of the most important groups of foreign trade shows that oil, petroleum products, natural gas covers about 70% of Russian exports. And due to the high correlation of crude oil, petroleum, gas indices it became possible to use the price index of oil as a substitute for our entire index of export prices.

The media names as one of the causes of the 2014–2015 currency crisis the falling prices of oil on international markets (for example, the statements by chairman of the Central Bank E. Nabiullina, minister of economic development A. Ulyukaev, minister of Finance A. Siluanov, etc.) It is important to note that many analysts use the price index of oil as a determinant of exchange rate dynamics. As you know in the foreign exchange market, expectations are most often true. It is interesting to note that, for example, in the author's paper (Kuzmin, 2010b) also shows that in certain periods of time, when used as the determinants of price index, Brent-mix of oil as a substitute for actual average export prices  $P_i^*$ , than the currency rate  $e(P^*(oil))$  approximates the official ruble exchange better than any other settlement rate.

Table 1 presents the price of brent-mix blend crude oil on ICE (Intercontinental Exchange, the data from Bloomberg, U. S. dollars per barrel). As determinants of P was used the consumer price index (CPI). As determinants of Q was used the index of the real GDP.

**Setting up the internal model coefficient.** In the process of verification and elaboration of methodological recommendations on the use of the model it was carried out to configure the internal coefficients (the coefficient  $\theta$  of the basic formula research (8)).

For a given coefficient  $k$ , equal to the rate of the ruble at the start point of the period minimized the sum of squared normalized differences of the calculated rate (8) and the nominal exchange rate  $e$  (nominal) provided that the indexes at the start point of period were  $P(start) = 1$ ,  $P^*(start) = 1$ ,  $Q(start) = 1$ :

$$\min_{\theta} \sum_t \left( \frac{e_t(\theta) - e(\text{nominal})_t}{e(\text{nominal})_t} \right)^2.$$

As simulation results of modeling it is necessary to set the parameter  $\theta$  value in terms of  $\theta \geq 0$ .

In this period of time as the nominal exchange rate is considered the nominal rate of the US dollar against the ruble at the end of the period (month), calculated by the Central Bank of Russia and presented in table 2.

As a result of numerical simulation for a given coefficient  $k = 32,73$  was set the parameter value  $\theta$ , amounting to  $\theta = 0,45$ .

In Table 3 and Figure 1 (author's calculations, monthly data) presents:

1. Dynamic calculation of the ruble on the basic formula of research (8) if  $\theta = 0,45$  ( $e$  (Theor), line 1).
2. Normalized deviation values of the nominal and calculated exchange rate of ruble (line 2)

**Table 1.** Dynamics of key economic indicators – fundamental determinants of the model in 2013–2015. (December 2013 taken as a unit).

	December 2013	January 2014	February	March	April	May	June	July
<b>ICE BRENT</b> (U. S. dollars per barrel)	103,680	100,450	103,400	102,990	102,630	104,270	108,500	106,240
<i>The cumulative index</i>	1,000	0,969	0,997	0,993	0,990	1,006	1,046	1,025
<b>CPI (2000 =100)</b>	405,9	408,3	411,2	415,3	419,1	422,8	425,5	427,5
<i>The cumulative index</i>	1,000	1,006	1,013	1,023	1,033	1,042	1,048	1,053
<b>Real GDP – p rices with reference to 2008, quarterly data</b>	11956,0	9745,8	9745,8	9745,8	10464,6	10464,6	10464,6	11504,7
<i>The cumulative index</i>	1,000	0,815	0,815	0,815	0,875	0,875	0,875	0,962

**Continuation of table 1**

	August	September	October	November	December	January 2015	February
<b>ICE BRENT</b> (U. S. dollars per barrel)	104,520	97,150	88,280	72,240	60,220	55,000	63,150
<i>The cumulative index</i>	1,008	0,937	0,851	0,697	0,581	0,530	0,609
<b>CPI (2000 = 100)</b>	428,6	431,4	434,9	440,5	452	469,4	479,8
<i>The cumulative index</i>	1,056	1,063	1,071	1,085	1,114	1,156	1,182
<b>Real GDP – prices with reference to 2008, quarterly data</b>	11504,7	11504,7	12007,5	12007,5	12007,5	12007,5*	12007,5*
<i>The cumulative index</i>	0,962	0,962	1,004	1,004	1,004	1,004	1,004

\* Extrapolated data

Source: Bloomberg (reference date: 22.04.2015)), data of Federal service of state statistics (www.gks.ru (accessed: 24.05.2015)).

**Table 2.** Dynamics of the nominal exchange rate US dollar to ruble in 2013–2015.

	December 2013	January 2014	February	March	April	May	June	July
Nominal exchange rate of the US dollar against the ruble at the end of the period	32,73	35,24	36,05	35,69	35,70	34,74	33,63	35,73

Continuation of table 2

	August	September	October	November	December	January 2015	February
Nominal exchange rate of the US dollar against the ruble at the end of the period	36,93	39,39	43,39	49,32	56,26	68,93	61,27

Source: data of the Central Bank of Russia (reference date: 17.05.2015).

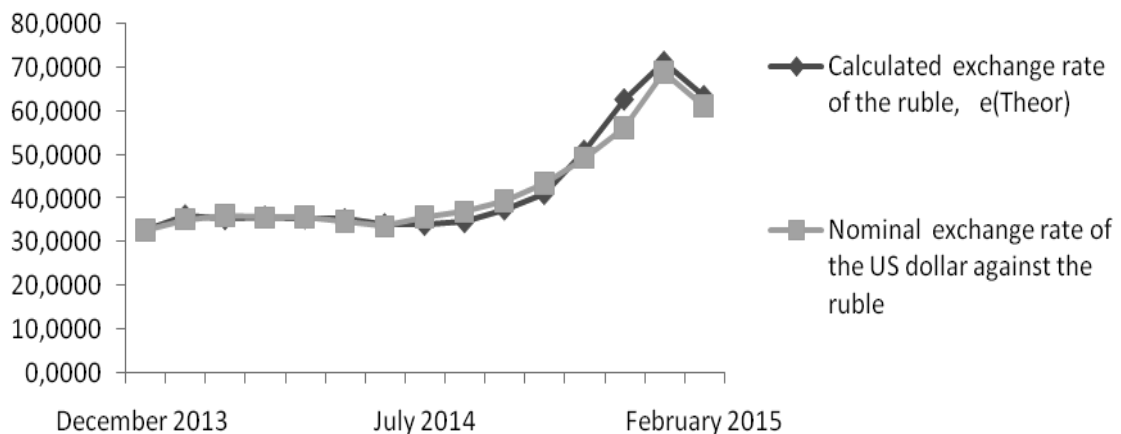
$$ND(\hat{a})_t = \frac{e_t(\theta) - e(\text{nominal})_t}{e(\text{nominal})_t}$$

**Table 3.** Dynamics of the nominal exchange rate US dollar to ruble in 2013–2015.

	December 2013	January 2014	February	March	April	May	June	July
Calculated exchange rate of the ruble, e (Theor)	32,73	36,16	35,38	35,87	35,55	35,30	34,14	34,04
Normalized deviation, ND		0,0260	-0,0187	0,0051	-0,0042	0,0161	0,0152	-0,0474

Continuation of table 3

	August	September	October	November	December	January 2015	February
Calculated exchange rate of the ruble, e (Theor)	34,69	37,56	41,13	50,91	62,67	71,26	63,44
Normalized deviation, ND	-0,0608	-0,0464	-0,0520	0,0323	0,1139	0,0338	0,0354



**Fig. 1.** The calculated and nominal rates of US dollar to Russian ruble (December 2013 – February 2015, author's calculations).

The average absolute normalized deviations and average normalized deviations of the nominal and calculated exchange rate of ruble were, respectively, 0.28% and 2,98%, which indicates the high quality of the model.

## CONCLUSION

Looking at some results of the conducted analysis it is possible to allocate the main causes of the fall of the nominal exchange rate of US dollar against the ruble in the period of December 2013 – February 2015: the substantial (actually twofold) fall in export prices of oil and other energy resources on international markets as a result of worsening global conditions. This is due to the overwhelming predominance of mineral commodities in the index of average actual export prices. However, it should be noted that in this period a significant effect on the result was an increase in consumer prices (18,2%) with incomparably low impact of the short-term fall in GDP.

The development of a new approach to modeling the dynamics of exchange rates has led to the construction-based model of equilibrium dynamics of exchange rate of ruble. As the basic determinants in the model are used: export-import operations, factors of capital flows, terms of trade, indexes of domestic and export prices and real GDP, the elasticities of foreign trade, intermediate-run solution of microagents.

In the process of creating the model was based on a number of key internal dynamic functional dependencies: export-import operations, and the movement of capital. That allowed us to put on formal logical level the capital flows in the model, and, thus, to extend the model to the case of capital mobility. The result was multifactor formula of the dynamics of the exchange rate of ruble

$$e(t, Q(t), P(t), P^*(t), \theta) = e_i = k \frac{P_i}{P_i^*} Q_i^{-2/3 \theta},$$

The results of the model can be seen not only in the context of the determination of dependence, but also as a balance equation. In practice, its use will give the Central Bank a tool to regulate the dynamics of the exchange rate in accordance with the dynamics of internal and external fundamental key economic indicators.

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# World Islamic Banking: Growth and Challenges Ahead\*

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**Abstract.** The object of the article is to give an overview on Islamic banks growth experience across the world from its initial stages till current situation with issues and challenges ahead. More specifically, the article focuses on Islamic banks in Russia, considering the fact that the country with over 20 million Muslims has only one bank (Badr-Forte) which offers Islamic financial services and a few institutions which provide halal investments in recent years, including Ak-Bars Bank in Tatarstan (non-Islamic Russian bank). But despite signs of growth, the country's pool of officially registered Islamic financial institutions remains limited to two organizations in Tatarstan and two in the republic of Dagestan in the North Caucasus. It is due to the Russian regulation system which is poorly suited for Islamic banks.

**Аннотация.** В данной статье рассматривается опыт роста исламского банкинга в мире, а также проблемы и барьеры, с которыми он сталкивался. В основном статья сфокусирована на исламском банкинге в России, где мусульманская община насчитывает более 20 миллионов человек и есть только один банк ("Бадр-Форте"), который с недавних пор предоставляет исламские финансовые услуги, а также несколько институтов по поддержке халяльных инвестиций, включая банк "АК Барс" в Татарстане (не исламский банк). Несмотря на рост, исламские институты ограничены только двумя организациями, которые находятся в Татарстане и Дагестане на Северном Кавказе. Это обусловлено плохой системой российского регулирования, в которой исламский банкинг плохо приживается.

**Key words:** Islamic finance, Islamic bank, QISMUT, growth rate, market share.

## 1. WHAT IS ISLAMIC BANKING; WHERE DID IT COME FROM AND WHERE IS IT GOING?

The core tenet of Islamic banking is a ban on *riba*, or interest, and loaning money for profit. The ban comes straight from the Prophet Muhammad, and is spelled out in the Qur'an.

On the face of it, such a ban should eliminate any possibility of sharia-compliant banking — but this is not actually the case.

The ban on "riba" prohibits making money from money. So instead, Islamic banks earn profits by co-investing in their clients' goods and businesses.

Islamic banks are also banned from financial speculation of any kind — where, again, money is made from money — as well as from investing in *haram*, or sinful, products, such as alcohol, pork and gambling.

The meticulously worded practices have seen a fair share of criticism from those who say they are just a piously worded cover-up for conventional banking. But in general, true Islamic banking is more client-

oriented: banks are supposed to go easy on borrowers in case of emergencies that render clients unable to pay, even up to forgiving their debts.

Moreover, the thrust of Islamic banking is founded on the desire to submit to the Divine Instructions on all transactions, particularly those involving exchange of money for money. However, it would be quite unfair to limit Islamic banking to elimination of *riba* only. *Riba* is but one of the major undesirable elements of an economic transaction, the others being *gharar* (risk or uncertainty) and *qimar* (speculation). While elimination of these objectionable aspects in a transaction is indeed a critical aim of Islamic banking, it is by no means its ultimate objective.

According to some, usury or excessive and exploitative charging of interest; while according to others, interest *per se* — is forbidden by the Qur'an. For example:

*"And that which you give in gift (loan) (to others), in order that it may increase (your wealth by expecting to get a better one in return) from other people's property, has no increase with Allâh; but that which you give in*

\* Мировой исламский банкинг: развитие и будущие вызовы.

*Zakât (sadaqa — charity etc.) seeking Allâh's Countenance, then those, they shall have manifold increase. Sura Ar-Rum (30:39)."*

*"That they took riba (usury), though they were forbidden and that they devoured men's substance wrongfully — We have prepared for those among men who reject faith a grievous punishment. Sura An-Nisa (4:161)."*

It has been argued in vain for long in some circles that the prohibition in Islam is that of excessive interest only or that it is the interest on consumptive loans that has been forbidden and as such loans extended for commercial purposes are entitled to an excess over the principle amount lent. Such tendentious arguing fails to give due understanding to versus 278 & 279 of Surah Albaqra (quoted below);

*"O ye who believe! Be afraid of Allah and give up what remains (due to you) from Riba (usury) (from now onwards) if you are (really) believers. (2:278)."*

*"And if you do not do it, take notice of war from Allah and His messenger! But if you repent, you shall have your capital sums. (2:279)."*

However, this does not mean that Islam prohibits any gain on principle sums. In Islam, profit is the recognized reward for capital. When capital employed in permissible business yields profit that profit (excess over capital) becomes the rightful and just claim of the owner of the capital. As a corollary, the risk of loss also rests exclusively with the capital and no other factor of production is expected to incur it. Another important element of Islamic finance is that profit or reward can only be claimed in the instance where either risk of loss has been assumed or effort has been expended. Profit is therefore received by the provider of capital and wages/remuneration by labor/manager.

A depositor in an Islamic bank can therefore make earnings on his or her deposit in several ways:

- Through return on his capital when that capital is employed in a business venture.
- Through sharing of profit when his capital is part of capital employed in a partnership, and finally,
- Through rental earnings on an asset that has been partially financed by his capital.

As with all things Islamic, the origination of Islamic finance goes back to the time of Prophet Muhammad. The Qur'an and the example of Prophet Muhammad provide direct behavioral guide and represent bedrock of Islamic faith to over one billion Muslims globally. The Prophet Muhammad happened to be a businessman serving as a trader for Khadija. The Prophetic example was the very epitome of fair-trade. Refraining from usury, ensuring transparency in transactions, and total honesty entitled him Al-Amin (The Trustworthy) in pre-Islamic Arabia (Sufyan, 2007).

In Muslim communities, limited banking activity, such as acceptance of deposits, goes back to the time of the Prophet Muhammad. At that time people deposited money with the Prophet Muhammad or with Abu Bakr Sedique, the first Khalif of Islam.

In order to avoid manifestation of Islamic fundamentalism which was anathema to the political regime, the first modern experiment with Islamic banking was undertaken in Egypt under cover without projecting an Islamic image. Ahmad El Najjar made pioneering effort and established a Savings Bank based on profit-sharing in Egyptian town of Mit Ghamr in 1963. There were nine such banks in the country by 1967. These banks, which neither received nor paid any interest, invested mostly by engaging in trade and industry, directly or in partnership with others, and shared the profits with their depositors (Siddiqi, 1988). These banks were functioning essentially as saving-investment institutions rather than as commercial banks. Although its charter made no reference to Islam or Sharia (Islamic law), Nasir Social Bank, established in Egypt in 1971, was declared an interest-free commercial bank (Arif, 1988).

In the seventies, because of changes that took place in the political climate of many Muslim countries, there was no longer any strong need to establish Islamic financial institutions under cover. Both with letter and spirit, a number of Islamic banks were established in the Middle East, e.g. the Dubai Islamic Bank (1975), the Faisal Islamic Bank of Egypt (1977), the Faisal Islamic Bank of Sudan (1977), and the Bahrain Islamic Bank (1979), to mention a few.

A number of banks were also established in the Asia-Pacific region in response to these winds of change, e.g. The Philippine Amanah Bank (PAB) was established in 1973 as a specialized banking institution by Presidential Decree without reference to its Islamic character in the bank's charter. The PAB is not strictly an Islamic bank; nevertheless, efforts are underway to convert the PAB into a full-fledged Islamic bank (Mastura, 1988). Its interest-based operations continue to coexist with the Islamic modes of financing. PAB operates two 'windows' for deposit transactions, i.e., conventional and Islamic (Arif, 1988). Islamic banking was introduced in Malaysia in 1983, but not without antecedents. Muslim Pilgrims Savings Corporation (MPSC) was the first (non-bank) Islamic financial institution in Malaysia set up in 1963 for people to save for performing *hajj* (pilgrimage to Mecca and Medina). MPSC was evolved into the Pilgrims Management and Fund Board in 1969, which is now popularly known as the Tabung Haji. The success of the Tabung Haji also provided the main thrust for establishing Bank Islam Malaysia Berhad (BIMB), which represents a full-fledged Islamic (commercial)

bank in Malaysia. Bank Islam Malaysia Berhad (BIMB) was set up in July 1983 with paid-up capital of RM 80million (Arif, 1988 and BIMB).

The Organization of Islamic Countries (OIC) established Islamic Development Bank (IDB) in December 1973 with the purpose to foster economic development and social progress of member countries and Muslim communities individually as well as jointly in accordance with the principles of Sharia i.e., Islamic law. The IDB not only provides fee-based financial services but also provides financial assistance on profit-sharing bases to its member countries (Source: IDB).

Reference should also be made to some Islamic financial institutions established in countries where Muslims are a minority. There was a proliferation of interest-free savings and loan societies in India during the seventies (Siddiqi, 1988). The Islamic Banking System (now called Islamic Finance House), established in Luxembourg in 1978, represents the first attempt at Islamic banking in the Western world. There is also an Islamic Bank International of Denmark, in Copenhagen, and the Islamic Investment Company has been set up in Melbourne, Australia (Arif, 1988). In the late 20th century, a number of Islamic banks were created, to cater to this particular banking market.

From a humble beginning in a small village in Egypt in the late 60s, it has now spread to the four corners of the world. By normal standards in a time span that is less than half a century it could have hardly been expected to establish foothold in Islamic world, let alone make its presence felt in Muslim-minority countries. Yet such has been its phenomenal rate of growth that not only is taking firm roots in its homestead, but is also attracting genuine interest among standard barriers of conventional banking and in swathes of land where Muslims are a small minority only.

### 1.1 MAIN FEATURES

The salient features of the proposed system are: 1) There is no interest on deposits, but capital is guaranteed; 2) Lending and investing are treated differently; loans are interest-free but carry a service charge, while investing is on a profit- and loss-sharing (*Mudaraba*) basis. Conventional banks will grant loans but they will not engage in investment-financing. Investment-financing will be done through investment banks and investment companies.

### 1.2 ZERO INTEREST AND CAPITAL GUARANTEE

Muslims are prohibited by their religion to deal in interest (*riba*) in any way. Giving and receiving as well as witnessing are all prohibited. Thus an Islamic banking system as it is mentioned can not pay any interest to its depositors; neither can it demand or

receive any interest from the borrowers. Nor could the banks witness or keep accounts of these transactions. But the lender is entitled to the return of his capital in full. This is a Qur'anic injunction<sup>1</sup>, and the proposed system complies with these fundamental Islamic requirements.

A basic tenet of commercial banking is capital guarantee. The capital entrusted to the bank by a depositor must be returned to him in full. The proposed system fully complies with this requirement. Islamic banking as practiced today does not provide capital guarantee in all its deposit accounts. In many countries, this is one of the two main objections to permitting the establishment of Islamic banks. There is no objection to paying zero interest on deposits.

Thus, by paying zero interest and guaranteeing capital, the proposed system satisfies both the *riba*-prohibition rule of Islam and the capital guarantee requirement of conventional banking acts. This enables it to obtain permission to set up and operate as a deposit bank in all countries of the world, while obeying the *riba*-prohibition rule and qualifying to be an "Islamic" bank (Gafoor, 1995).

### 1.3 LENDING AND INVESTING

In conventional banking, depositing is a form of investment for the savers where the capital remains intact while a known income (in the form of interest) is promised. To the banks lending is a form of investment where the capital and a known return are assured and the return will also cover all their costs. Since Islam prohibits dealing in interest in any form this type of banking is not acceptable to the Muslims.

In Islam, there is a clear difference between lending and investing. Lending can be done only on the basis of zero interest and capital guarantee, and investing only on the basis of *Mudaraba* (profit- and loss-sharing). Conventional banking does not make this differentiation and does not need to. An Islamic bank has to take this into consideration in devising a system to cater to the Muslims. Therefore such a system has to provide for two sub-systems, one to cater to those who would "lend" and another for those who wish to invest.

In the proposed system, the depositors are considered as lenders to the bank and, since a Muslim lender cannot receive any interest, he lends without interest but with the assurance that his capital will be returned in full. This applies to demand (current account) deposits as well as to savings deposits. The bank, in turn, lends (the depositors' funds) to the borrower who should pay a remuneration (or profit)

<sup>1</sup> Qur'an, 2:279.

to the bank for providing these services. This suits some depositors and some borrowers.

Further in conventional banking those who wish to earn an income using their savings do so by putting their capital in savings deposits or time (fixed) deposits and receive an interest payment. A Muslim cannot earn an income but he participates in a project by financing it and by sharing in its loss or profit (Ghafoor, 1996).

## 2. ISLAMIC BANKS GROWTH EXPERIENCE AND CHALLENGES

In three decades, Islamic banks have grown in number as well as in size worldwide and are being practiced on even more intensive scale. Some countries like Sudan and Iran, have converted their entire banking system to Islamic banking. In other countries, where conventional banking is still dominating, the Islamic Banking is operating alongside (Agarwal, 2003).

Islamic banks have more than 300 institutions spread over 51 countries, including the United States through companies such as the Michigan-based University Bank, as well as additional 250 mutual funds that comply with Islamic principles. It is estimated that over US\$ 822 billion worldwide sharia-compliant assets are managed (*The Economist*, 2012).

Gradual and steady spread of the Islamic banks over time over the world is a lucid manifestation of success and the symbolic growth rate is the hallmark of this emerging market. Being fastest growing segment of the credit market in Muslim countries, market share of Islamic banks in Muslim countries has risen from 2% in the late 1970s to about 15 percent today (Aggarwal and Yousaf, 2000). Islamic banking is getting popularity, warm welcome, and appreciation also by non-Muslims in Muslim and non-Muslim countries. According to Yudistira (2003), although most of the Islamic banks are within Middle Eastern and/or emerging countries, many universal banks in developed countries have started to spigot huge demand of Islamic financial products. This also confirms that Islamic banking is as viable and efficient as the conventional banking.

Nowadays, Islamic Banking assets with commercial banks globally are set to cross US\$ 1.7 trillion in 2013 suggesting an annual growth of 17.6% over last four years and it is expected that Islamic banking assets with commercial banks would grow at a CAGR (compound annual growth rate) of 19.7% over 2013–18 across the QISMUT (Qatar, Indonesia, Saudi Arabia, Malaysia, UAE and Turkey) countries to reach US\$ 1.6t by 2018.

One-fifth of the banking system assets across QISMUT have now transitioned to Islamic. In Saudi

Arabia, supply push has seen share of Islamic banking cross 50% of system assets.

The substantial pent-up demand promises a bright future. However, the volatile nature of some of the newly emerging Islamic finance markets implies that growth gets adversely affected by politics and social upheaval.

Although there is a noticeable slowdown caused by two major developments. First, the continuing economic and political setbacks in some of the frontier Islamic finance markets; and second, the large scale operational transformation that many of the leading Islamic banks initiated about 18 months ago, which continues to consume focus and investment. (world Islamic banking report, 2014).

A major challenge for Islamic banks is to adjust the propositions, operating models, systems, tools and processes to understand and fully capitalize on the international opportunities provided.

According to World Islamic Banking Competitive-ness Report 2013–14, for 2012 the average ROE of the 20 leading Islamic banks was 12.6% compared to 15% for comparable conventional peers. The continued success in growing scale and operational transformation programs has the long-term potential to close the profitability gap with conventional banks. Many Islamic banks are already in the process of replacing or upgrading their core banking system, and should benefit from improved operations in the future.

Considering both a country's Muslim population and per capita income, the largest markets for Islamic finance include Turkey, Indonesia, Saudi Arabia, the United States, and France. The fastest growing markets are Malaysia, Bahrain, the United Arab Emirates, Indonesia, and Pakistan.

The potential for continuous growth in the Islamic finance sector is significant, with some estimates suggesting that within eight to ten years as much as half the savings of the world's 1.5 billion



**Figure 1.** Islamic banking assets with rapid-growth markets.

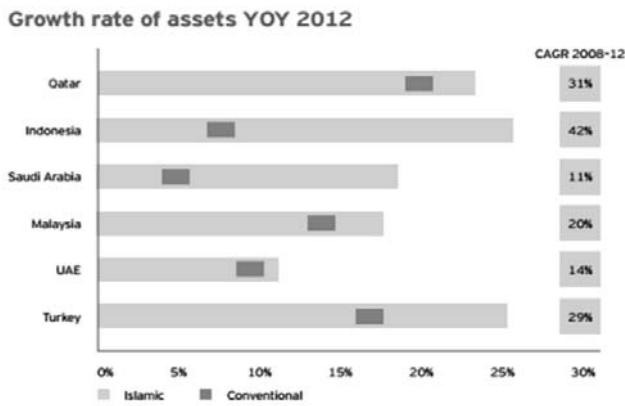


Figure 2. Growth rate in QISMUT.

Muslims will be in Islamic banks. This could represent \$ 905 billion in total assets in Middle Eastern countries alone<sup>2</sup>. Muslims living outside of the Middle East represent an even larger population, including countries such as India, Indonesia, and Malaysia, but also within developed countries including the United Kingdom, France, Germany, the Netherlands, and the United States.

Islamic banks face several important barriers to becoming competitive with conventional banks. Currently, Islamic finance instruments are more expensive, less service oriented, and not as responsive to innovation. These disadvantages could hold important implications for developing consumer markets and financing trade in Muslim countries<sup>3</sup>.

Rather than charging interest, Islamic financial institutions will typically share some of their borrowers' risks and profits (Donald Greenless, 2005). (A bank's profit from a 'loan' will vary with the borrower's profits from the application of the loan to new business activity.) Islamic finance also avoids speculation (e.g. reliance on the occurrence of events that may or may not take place), and investing in ventures that may have components that are not in line with the values of Islam (alcohol, gambling, drugs and tobacco) (*Khaleej Times*, 2005). Still, although Islamic financial principles may differ from those of conventional banks, in practice many differences tend to be negligible, and Islamic financial products look a lot like conventional mortgages, leasing, and business lending. Sharia-compliant financial products have expanded to include bonds, mutual funds, and insurance, traditionally an area of great debate among Sharia-compliant financiers (*International Herald Tribune*, 2005).

The growth of Islamic finance has helped to diversify markets and institutional structures, particularly

<sup>2</sup> Conventional financial institutions manage \$ 1.1 trillion in Islamic funds (*Khaleej Times*)

<sup>3</sup> Institute of Islamic Banking and Insurance.

in oil-rich Muslim countries, but also in countries with large Muslim minorities.

Islamic banks operate in countries that have adopted Islamic sharia principles (e.g. Iran, Pakistan, and Sudan), Muslim countries with both Muslim and conventional banks, and in developed countries side-by-side with conventional banks (Karbhari, Yusuf, Naser, Kamal, and Shahin, Zerrin, 2004).

In the United States, particularly in California, New York, and Michigan, Islamic finance has also grown rapidly. There are an estimated six million Muslims in the United States and about one-third of the 1.8 million household's desire Islamic financing, especially for home mortgages. Banks in the United States generated nearly \$ 300 million in revenue from Islamic financing in 2004 and approximately \$ 450 million in 2005, including \$ 300 million in Islamic mortgages.

There were roughly 2.8 million Muslims in the United States as of 2010, according to the Pew Research Center's Religion and Public Life Project, though estimates vary. The most recent study published by the Association of Statisticians of American Religious Bodies estimates that Islam was the

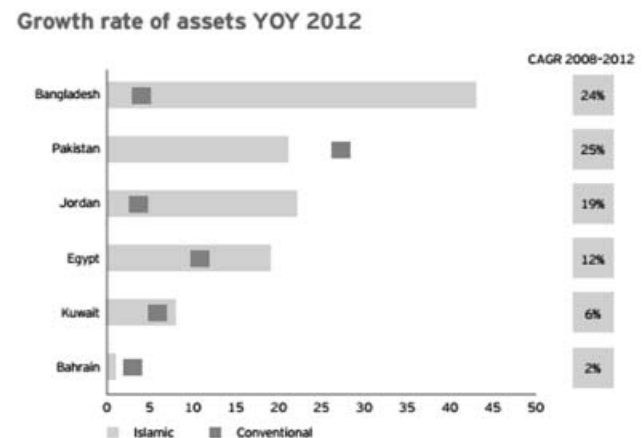


Figure 3. Growth rate in Middle East.

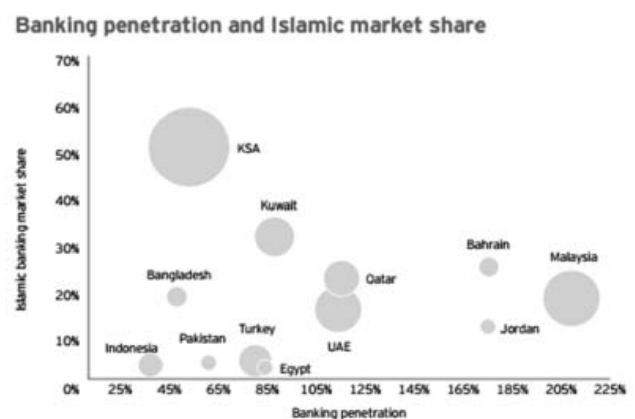


Figure 4. Banking penetration.

fastest-growing religion in the United States between 2000 and 2010. Yet there are relatively few financial products available here for those followers who require their financial contracts to comply with sharia law.

Globally, the Islamic finance industry is between \$ 1 trillion and \$ 1.5 trillion in size, according to the World Bank, in the vicinity of Australia's or Spain's gross domestic product. It's unsurprising, perhaps, since Muslims are almost a quarter of the world's population. That's an upper bound on the demand for Islamic finance, since not all Muslims demand sharia-compliant contracts. But in Muslim-majority countries like Bangladesh, Islamic financial products constitute as much as two-thirds of total financial sector assets. There are more than 400 Islamic financial institutions across 58 countries. Roughly 5 percent of total Islamic financial assets are housed in non-Muslim regions like America, Europe, and Australia.

The United States' Muslim population is roughly equal to that of the United Kingdom, a country that houses \$ 19 billion in Islamic financial institution assets, more than 20 banks, and six that provide sharia-compliant products exclusively. Yet our market for Islamic financial products is much smaller. There's no single list of participating firms or aggregate estimate of assets, but one can find roughly a dozen firms that routinely offer Islamic banking and investment products to businesses and consumers, though several don't even market such products on their websites.

At the same time, this is an industry on the rise. Just 20 years ago, there were few Islamic financial products being offered at all in the United States. The industry is rapidly growing and adapting to American regulation (Haltom, 2014).

Islamic finance has quickly established itself in several markets, but its spread, growth, and ultimately its character, will depend on how it confronts several key challenges, including the general acceptance of Islamic finance, regulatory and soundness compatibility, obstacles to innovation, and other important barriers such as building economies of scale and training professionals in the intricacies of Islamic financial products. Many potential customers are not clear about what Islamic banking is and how it differs from conventional banking (Ainley, M. 1997). The strong and increasing desire of Muslims to more closely link their investment and lending decisions with their religious views is the key distinction in market segment that might otherwise suffer from large disadvantages in price, performance, service, and innovation. The willingness of customers to accept added complexity, higher costs, and lower

performance in exchange for a closer alignment with religious beliefs will determine the near-term future of Islamic banking.

Islamic banking has been facing so many challenges since its origin. Islamic banking has been in transition and development phase in different countries for the last two decades. According to Khalaf (2007) Islamic banking industries have always suffered from the issue of different opinions of Islamic scholars, suppose a product or practice may be acceptable to one scholar, while could be considered un-Islamic by another scholar. Malaysia has established a standard sharia board which is supported by government. The Bahrain-based Accounting and Auditing Organization for Islamic Financial Institutions has established a group of religious advisors or scholars who are authorized to issue *fatwas* (order, decision) on Islamic financial products. But it remains a voluntary body; they are not strictly imposing these rules on these organizations, due to which some banks are ignoring the decisions of the board (Khalaf, 2007). It is true that Islamic banking is facing the difficulties of lack of authentication of decisions because there is no unity in the Muslim community: they have different beliefs, and it is possible that some decisions are not acceptable to one part of community.

Another significant problem for developing Islamic banking is keeping pace with investor demand for new and innovative products. Interpretations of Islamic finance often stall new projects, or at the other extreme, risk alienating a bank's client base. The ability of a bank to innovate depends on its capacity to get its products approved by its sharia supervisory council, made up of esteemed scholars conversant in Islam, economics, and finance, which recognize and sanction a bank's compliance with the requirements of Islam.

## 2.1 ISLAMIC FINANCE AND BANKING IN RUSSIA

There are about 15% Muslims population in Russia, but only four public organizations where they can invest and borrow in compliance with the Qur'an.

The first bank to offer Islamic financial services in Russia, Badr-Forte, started in 2006. The industry has been gradually sprouting ever since and lately seems to be making headway.

Several non-Islamic Russian banks have attracted *halal* investment in recent years, including Ak-Bars Bank in Tatarstan, which brought in a total of \$ 160 million in two investment deals in 2012 and 2013. But despite these signs of growth, the country's pool of officially registered Islamic financial institutions remains limited to two organizations in Tatarstan and two in the republic of Dagestan in the North Caucasus.

Islamic finance is a fast-growing field worldwide, and proponents say it offers both ethical and practical benefits to the faithful and non-Muslims, however, lags behind the industry. Russian Muslims are slow to change their financial habits, while nonbelievers are plagued by a deep-rooted distrust of Islam — as are, to some extent, the financial authorities, who are in no hurry to adapt economic legislation to facilitate Islamic banking.

Still, an Islamic finance industry has been budding over the past decade in Russia, and analysts and players show cautious optimism about its prospects.

"The niche is small, but the demand is better than, say, seven years ago" (Rashid Nizameyev, the head of finance house Amal).

The financial merit of the Islamic system is a more complicated issue. Islamic banking offers better interest rates; However, in general, Islamic banking operations are less profitable than conventional banking, but banks can make up for that by devoting a bigger share of the profits to dividends. On the other hand, Islamic banking is more client-friendly, because of its ban on financial speculations, interest in Islamic banking has even peaked worldwide since the last recession — though not necessarily in Russia.

In Russia the Islamic finance market is in "embryonic stage". the total volume of assets managed by Russian *halal* financial institutions is at \$ 10 million, a blip on the radar for the country's banking system, whose total assets stood at 57.4 trillion rubles (\$ 1.7 trillion) in 2013 (Juravliov, 2014).

The prospects for growth may seem glorious, given the size of Russia's Muslim population.

Russian regulations are also poorly suited to Islamic banking: Russian banks are supposed to refrain from trade operations, in which they would technically engage when providing many Islamic banking services.

Another problem is widespread distrust of Islam, a result of the 15 years of violent turmoil in the largely Muslim North Caucasus. Many officials share this antipathy, which is why they have little desire to modify Russian legislation for the industry. Although the situation is better in the Muslim heartlands: For example, authorities in Tatarstan are interested in supporting Islamic finance and have hosted numerous conferences on the matter. However, this support has yet to translate into some kind of financial backing or tax breaks. The industry still has plenty of room to grow — Thomson Reuters forecasts that Islamic banking assets in Russia will reach up to \$ 10 billion by 2018.

### 3. CONCLUSION

Islamic finance has become a mainstream funding source for some other governments and companies over the past several years, with even non-Muslim

nations such as Britain and South Africa issuing debut Islamic bonds [*sukuk*] and other Islamic instruments.

Considering the growth of Islamic banks across the world, some non-Muslim countries like Russia are trying to adopt and use more of Islamic finance services: some Russian lenders are trying to build their own in-house knowledge of Islamic finance. It is due to recent sanctions, as in the Vnesheconombank (VEB), which has been targeted by the sanctions, is seeking help Middle East firms to develop its Islamic finance expertise.

The regulator continues to study the question of introducing Islamic finance regulation but work is at an early stage and it is not yet clear when any new rules would be drafted.

In case of challenges, Islamic banks must overcome other competitive issues if they are to offer competitive pricing and the same innovative advantage as conventional banks. In some countries, market demand for Islamic banking services may never be large enough to warrant the creation of banks with efficient scale, so national consolidation of existing Islamic banks may not always be a viable solution. Although merging with a conventional bank might be a possible alternative, this could jeopardize the legitimacy and credibility of Islamic bank's financial products.

Finally, the differences in the structure of products across countries — or even from one bank to another — add to the difficulties of cross-border expansion and back-office outsourcing.

The Islamic finance market is a rapidly growing sector. Successful market entry will require careful planning, flexibility to change as the sector evolves, and broad understanding of not only Islamic finance and Islam in general, but the particular region, or sub-population to be targeted by a market strategy.

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# Internal Control, Peculiarities of Application of the Requirements of the Sarbanes-Oxley Act and COSO Model\*

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**Abstract.** In this paper we focus on the benefit of effective internal controls, or more precisely, the Sarbanes-Oxley Act (SOX) and COSO model. We examine this issue in the context of the Sarbanes-Oxley Act for corporate control and, consequently, how weak internal control determines the reliability of financial data. This paper examines how SOX 302, 404, 906 disclosures on the internal control environment affect the market for corporate control. Besides that, we analyzed COSO model and how the sections of these laws may be implemented in practice.

**Аннотация.** В данной статье мы проанализировали преимущества эффективного внутреннего контроля, или точнее сказать, закона Сарбейнса – Оксли (SOX) и модели COSO. Мы рассмотрели, в частности, каким образом закон Сарбейнса – Оксли влияет на корпоративный контроль и как слабый внутренний контроль определяет достоверность финансовых данных. В настоящем документе более подробно были рассмотрены такие разделы закона SOX, как 302, 404, 906, раскрытие информации о системе внутреннего контроля, и как они влияют на рынок корпоративного контроля. Кроме того, мы проанализировали модель COSO, а также каким образом данные законы могут быть реализованы на практике.

**Key words:** SOX, COSO, audit, internal control, financial reporting reliability, internal control deficiency.

## INTRODUCTION

Until recently, the concept of "internal control and audit" has been known to domestic business very remotely. Today, the situation has changed radically. Large companies and enterprises actively create departments for internal control and audit services, preferring to train its own employees (accountants, economists, financiers). At the same time, in foreign countries the audit is actively used since the late nineteenth century by the medium and large industrial enterprises, construction enterprises, organizations of transport and communications, and in other areas with a complex management structure. The high quality of audit is necessary for the effective functioning of the quality management system. The relevance of the work is manifested in the fact that internal audit provides information to the higher-level management of the entire organization about its financial and economic activity, increases the effectiveness of the internal control system to prevent violations, and confirms the validity of the reports of its structural subdivisions. An important trend of development control in the world

globalization is the growing importance of the independent objective audit.

According to the Institute of Internal Audit the internal auditing may be defined as "an independent, objective assurance and consulting activity designed to add value and improve organization's operations". Besides that it may help the organization to reach its objectives by bringing a systematic, carefully disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes.

Nowadays internal audit covers a wide range of different aspects of the organization, helping management to identify and assess risks and to develop measures aimed at reducing the risk and improving the efficiency of systems and processes. Internal audit includes the reliability of financial and operational information, effectiveness and efficiency of business operations, protection of assets, compliance with laws, government regulations, procedures, and contracts. Evaluation of the internal control is one the primary responsibilities of internal auditing.

Compliance with the requirements of the Sarbanes – Oxley Act has become a worldwide practice

\* Внутренний контроль, особенности применения требований закона Сарбейнса – Оксли и модели COSO на практике.

of business, and many companies, including Russian companies, apply its provisions. The Sarbanes-Oxley Act was enacted in 2002 after a number of corporate scandals in the United States, connected with disturbances in corporate governance and financial reporting in the cases of Enron, Tyco International, Peregrine Systems, World-Com, which led to multimillion investors' losses. The management of Enron created thousands of legal entities, mainly offshore in order to conceal the true state of affairs. All transactions with electricity were conducted through its subsidiaries, allowing to inflate the cost of the company. As a result, the company grew, the management received multimillion bonuses, increased cost of stock and their packages. The leadership has managed to obtain a profit from offshore. The main financier of Enron, Andrew Fastow, the main ideologist of this whole scheme, was able to get from offshore \$ 30 million. For the tax authorities, the company showed all their losses, being unprofitable and received tax refunds in the amount of 380 million dollars. Enron employed the best lawyers and accountants, so one would expect that any action could be recognized as legitimate.

The Sarbanes-Oxley Act of 2002 is also known as the Public Company Accounting Reform and Investor Protection Act, and commonly called "SOX" or "Sarbox".

The law has 11 sections, which address the issue of auditor independence, corporate responsibility, full financial transparency, conflicts of interest, corporate financial reporting, etc. According to the Law, every public company must be listed by the audit committee. The Sarbanes – Oxley Act is mandatory for all companies whose securities are registered with the Securities and Exchange Commission (U.S. SEC), residents and non-residents of the USA, whose shares are listed on the American stock exchanges (NYSE or NASDAQ). Even Russian companies apply the mandatory provisions of SOX – such as VypelCom, MTS, Mechel – as well as numerous subsidiaries of foreign issuers registered with the SEC.

### **SARBANES OXLEY AUDIT REQUIREMENTS**

The Sarbanes Oxley Act requires all financial reports to include an Internal Controls Report. It means that a company's financial data are accurate and adequate controls are in place to safeguard financial data. Year-end financial reports are also a requirement. A SOX auditor is required to review controls, policies, and procedures according to a Section 404 of the law. SOX auditing requires that internal controls and procedures can be audited using a control framework.

In accordance with the Sarbanes-Oxley Act, each public company should establish an audit committee, whose members are independent and are part of the Board of Directors. In this case, to ensure the independence of the members, the audit committee may not receive from the company any payments for advice and to have any relationship with the company or its subsidiaries, except to perform the functions of members of the Board of Directors. The audit committee must have at least one financial expert with knowledge of generally accepted accounting standards (GAAP) and financial statements, as well as with experience of auditing financial statements. The duties of the audit committee include the appointment, control, payment services internal auditors, who report directly to the committee, as well as all audit and other services provided by the company's external auditors. The main influence of the SOX on the organization, and main responsibilities and business connections between departments are shown below in the Exhibit 1 (Source: Arthur Franczek).

Financial statements of the listed companies and submitted to the Securities and Exchange Commission, signed by the CEO and CFO. In case of reissuing financial statements in connection with the failure to coincide with the requirements for its preparation, the CEO and CFO should lose the bonus and any additional payments, and income from the sale of securities of their company, in their possession, which are received within 12 months after the publication of the financial statements, containing inaccurate data.

Perhaps the most controversial parts of SOX are its additional requirements on internal controls (Sections 201, 302, 404 and 906).

Section 201 has made it illegal for a registered public accounting firm to contemporaneously perform both audit and non-audit services for a client. The prohibitions include internal auditing, many areas of consulting and senior officer financial planning. Other services prohibited are:

- Financial information systems design and implementation;
- Bookkeeping and financial statement services;
- Management and human resource functions;
- Actuarial, investment advisor and audit-related legal services, but tax services are not prohibited.

Section 302 requires CEOs and CFOs personally to certify the accuracy of the financial statements and the effectiveness of internal controls, in addition to management's evaluation and certification. Three conditions must exist for a registrant to disclose an internal control deficiency under Section 302. Firstly, an internal control deficiency must exist; secondly, management or the independent auditor must discover the deficiency; and thirdly, management, per-

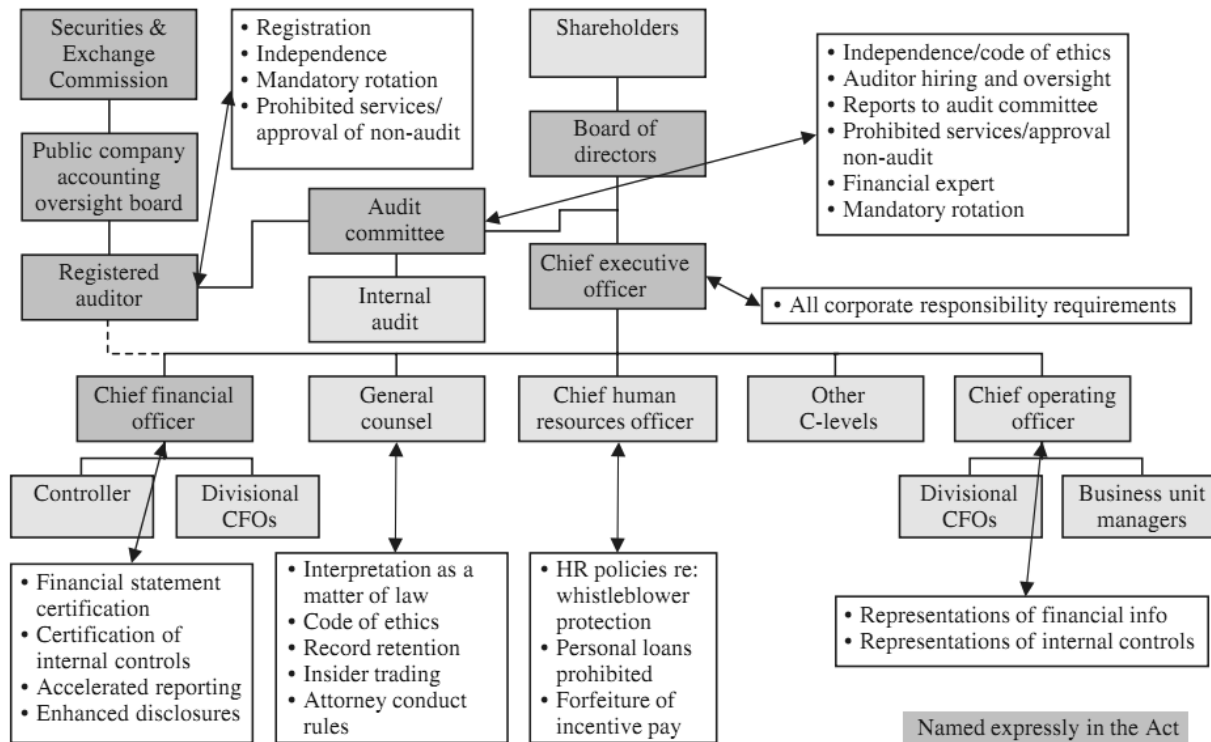


Figure 1. How SOX influences an organization.

haps after consultation with its independent auditor, must conclude that the deficiency should be publicly disclosed. Under the provisions of Section 302, the review of internal control is subject to less scrutiny by both management and the auditor and the disclosure rules are less specific than subsequently exist under Section 404 (Hollis Ashbaugh-Skaifea, Daniel W. Collins, William R. Kinney Jr, 2007).

Section 404 requires independent auditors to certify management’s assertion of the effectiveness of its internal controls (Ge, W., McVay, S., 2005). Section 404 requires top management to assess the effectiveness of internal controls over financial reporting and the external auditor to attest and report on management’s assessment. The dispute surrounds the costs and benefits of the required disclosures. Direct benefits seem to be elusive (e.g., Ogneva, Subramanyam, and Raghunandan, 2007). Costs appear to be high: empirical evidence suggests that SOX imposed net costs on shareholders (Zhang, 2007, Ashbaugh-Skaif *et al.*, 2009) and bondholders (DeFond, Zhang, 2007).

**SECTION 404 MANAGEMENT ASSESSMENT OF INTERNAL CONTROLS**

Section 404 is the most complicated, and most expensive to implement of all the Sarbanes Oxley Act sections for compliance. All annual financial reports must include an Internal Control Report stating that management is responsible for an internal control

structure, and an assessment by management of the effectiveness of the control structure. Any defects in these controls must also be reported. In addition, registered external auditors must attest to the accuracy of the company management assertion that internal accounting controls are in place, operational and effective.

Section 404 of the Sarbanes-Oxley Act requires that when preparing reports according to the SEC the company executives provide confirmation of the effectiveness of internal control procedures over financial reporting. This unit should include in the annual report the company’s own assessment of the work of the management in accordance with accepted standards. This section causes the greatest difficulty in application, because most companies did not use detailed reporting to manage their cash flow. The responsibility of companies is the implementation of internal control systems, testing their effectiveness, assessing their vulnerability. Subject to section 404 of the company faces the challenges of shortage of qualified and experienced personnel, inefficiency of the internal control system, the lack of reliable methodology for financial reporting, the lack of human, technological and financial resources. All this resulted in the need to engage the services of outside advisors and auditors. The need to audit the internal control systems of companies, as required by section 404, has led to the increase in the cost of audit by an average of 30 per-

cent. When conducting research on the effects of Sarbanes-Oxley on the cost of equity results showed that the cost of own capital of the investigated companies fell after the entry into force of the law. However, when small and large firms are considered separately, it was found that the reduction in the cost of capital is typical for small firms.

The Sarbanes-Oxley Act has caused many companies to completely change the methods of reporting. These transformations do not occur without cost, but the benefits have repeatedly outweighed the costs. Many companies have benefited from the changes, the accounting standards have become more stringent during the period of validity of the law; the U. S. economy was able to avoid many corporate crises. Nevertheless, there were also plenty of companies that have failed to comply with the law. Many of them either are not market participants or were forced to place their shares outside the United States. Currently, according to corporate executives, the cost of internal audit is gradually reduced and is 30–40% less than when the system of internal financial audit was only introduced. The decrease in expenses is due to the fact that the employees of the companies are constantly engaged in the collection and control of financial information. When American corporations faced the need to adapt to the requirements of the new law, they were forced to apply to consulting firms and external auditors to assess the flows of financial intelligence. To date, all necessary procedures have been defined and a number of internal audit issues of the company can be solved on their own, which reduces the costs of external consultants.

## SECTION 906

Section 906 of SOX in some ways may be determined as a repeat of section 302 of SOX. It requires the CEO and CFO to certify in a written statement accompanying financial statements filed with the SEC the following:

- the report "fully complies with the requirements of section 13 (a) or 15 (d) of the Securities Exchange Act of 1934,"
- the information contained in the periodic report fairly presents, in all material respects, the financial condition and results of operations of the issuer."

Section 302 certification requires that the CEO and CFO make a statement based on their knowledge. No such qualification is provided for section 906. Either the statements fairly present or they do not. Besides that, section 906 adds a criminal provision to US laws. If a CEO and/or CFO provides an untrue certification, then it will be the US Department of Justice — not the SEC — that deals with the falsehood.

To be criminally liable, they have to have had knowledge. That is, under section 906, a CEO and/or CFO will be subject to criminal penalties only if it was proven that they knowingly made a false certification or willfully provided a false certification (U.S. Code § 1350).

Below is shown differences between Sections 302, 404 and 906 of the SOX.

## THE EFFECT OF SOX ON NON-US COMPANIES

Some specialists have asserted that Sarbanes-Oxley legislation has helped displace business from the USA and, specially, from New York to the United Kingdom, and its financial capital, London, where the Financial Services Authority regulates the financial sector with a lighter touch. In the UK non-statutory Combined Code of Corporate Governance plays somewhat similar role to SOX. A greater amount of resources is dedicated to enforcement of securities laws in the UK than in the US (Howell E. Jackson, Mark J. Roe). The Alternative Investment Market claims about its spectacular growth in listings almost entirely coincided with the Sarbanes Oxley legislation. In December 2006 Michael Bloomberg, New York's mayor, and Charles Schumer, a U. S. senator, expressed their concern (Bloomberg-Schumer Report). The Sarbanes-Oxley Act's effect on non-US companies cross-listed in the USA is different on firms from developed and well regulated countries than on firms from less developed countries, according to Kate Litvak. Companies from less and badly regulated countries benefit from better credit ratings by complying to regulations in a highly regulated country such as the USA, but companies from developed countries only incur the cost, since transparency is adequate in their home countries as well. On the other hand, the benefit of better credit rating also comes with listing on other stock exchanges such as the London Stock Exchange.

## INTERNAL CONTROL UNDER COSO MODEL

Evaluating internal controls is one of internal audit's primary responsibilities. The Institute of Internal Auditors (IIA) defines control, the control environment, and control processes as following: A control is any action taken by management, the board, and other parties to manage risk and increase the likelihood that established objectives and goals will be achieved. The high management of the organization should plan, organize, and even direct the sufficient actions in order to provide reasonable assurance that all strategic objectives and targets will be hit.

Comparison of Sections 302, 404 and 906

	Section 302	Section 404	Section 906
When is it effective?	August 29, 2002	Fiscal years ended on or after: <ul style="list-style-type: none"> <li>• November 15, 2004, for U.S. accelerated filers*</li> <li>• July 15, 2006, for foreign accelerated filers*</li> <li>• December 15, 2007, for others</li> </ul>	July 30, 2002
Who signs off?	<ul style="list-style-type: none"> <li>• CEO</li> <li>• CFO</li> </ul>	<ul style="list-style-type: none"> <li>• Management</li> <li>• Independent accountant</li> </ul>	<ul style="list-style-type: none"> <li>• CEO</li> <li>• CFO</li> </ul>
What's it about?	<ul style="list-style-type: none"> <li>• Executive certification issued quarterly</li> </ul>	<ul style="list-style-type: none"> <li>• Internal control report annually</li> <li>• Independent accountant attests to annual report</li> <li>• Quarterly review for change</li> </ul>	<ul style="list-style-type: none"> <li>• Abbreviated certification issued quarterly</li> <li>• Criminal penalties</li> </ul>
How often are the evaluations?	<ul style="list-style-type: none"> <li>• Quarterly evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Annual assessment</li> <li>• Quarterly review for change</li> </ul>	<ul style="list-style-type: none"> <li>• Quarterly evaluation</li> </ul>

Figure 2. Comparison of SOX sections.

The main purposes and objectives of the evaluation the internal control system may be defined as follows:

- Identification, assessment of the revealed violations and shortcomings for the purpose of informing the highest officials of the credit institution, heads of departments, elimination and prevention of violations and shortcomings in the future;
- Coordination of the strategic objectives of the credit institution in respect of the development of the internal control system with the operational objectives and tasks of the divisions and employees of the credit institution;
- Improving the risk management culture and level of control environment in the organization;
- Collecting data on risks for effective management;
- Checking compliance with normative acts of the Government and regulatory authorities on issues of organization and implementation of internal audit and control in business sphere of the organization;
- Timely and adequate response of the internal control system to change the terms of a credit institution activities (including changes in organizational structure, business processes with respect to their refinement and the introduction of additional control procedures), development of new and updating of existing regulations;
- Development of recommendations for to improve the reliability and efficiency of the components of the internal control system;

- Improvement of the internal control system.

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) gives the definition of internal control, which came from the report in 1992, as follows: Internal control is a process, effected by an entity’s board of directors, management and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance.

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) is a voluntary private organization established in the United States and intended for making appropriate recommendations to corporate management on critical aspects of organizational governance, business ethics, financial reporting, internal control, risk management companies and fraud.

COSO is dedicated to improving organizational performance and governance through effective internal control, enterprise risk management, and fraud deterrence. Five nonprofits are its sponsoring organizations: AAA (American Accounting Association), AICPA (American Institute of Certified Public Accountants), FEI (Financial Executives International), IIA (Institute of Internal Auditors), and IMA (Institute of Management Accountants). On May 14, 2013, COSO released an updated version of its Internal Control – Integrated Framework. COSO has developed a general model of internal control, in comparison with which companies and organizations can assess their control systems. The COSO model was especially important because the emphasis was made

on the responsibility of the leadership of organization for the state of control.

Basic concepts of the COSO model may be defined as follows:

1. Internal control is a process, that is, a means to an end, not an end in itself.
2. Internal control is carried out by people, so not only (and not so much) rules, procedures, and other guidance documents are important, but people at all levels of the organization.
3. From internal control owners and management one can only expect a reasonable level of assurance of achieving their goals, but no absolute guarantee of error-free operation.

Conceptual framework of internal control continues to act as the broadly accepted standard for satisfying the data requirements for reporting, however, in 2004 COSO published a conceptual framework of enterprise risk management. COSO believes that this model continues the review of internal control, with an emphasis on the broader concept of risk management.

Internal control ensures the achievement of a goal or several goals in related areas. According to COSO, internal control is a process carried out by the highest or supreme body of the company, determining its policy (Board of Directors, which represents the owners of the company), its managerial staff of the highest level (management) and all other staff, to ensure the achievement of following goals: feasibility and financial efficiency (including safeguarding of assets); reliability of financial reporting; compliance with applicable laws and regulatory requirements.

The conceptual basis of risk management organizations remains focused on the objectives of the organization; however, now includes four categories:

1. Strategic objectives (strategic) — high-level goals, aligned with mission/vision of the organization.
2. Operational objectives (operations) — effective and efficient use of resources.
3. Reporting objectives, objectives reporting (reporting — reliability of reporting).
4. Legislative objectives, objectives compliance (compliance) to compliance with applicable laws and regulations.

#### **FIVE BASIC COMPONENTS OF THE SYSTEM OF INTERNAL CONTROL. COSO MODEL**

The COSO Report defines five interrelated components of internal control that must be realized in practice:

1. **Control Environment** — The Control Environment sets the atmosphere in the organization, influ-

encing the control consciousness of its staff. It is the basis for all other components of internal control, providing discipline and structure. The factors of the control environment include the integrity, ethical values, style of management, the system of delegation of authority and management processes and staff development in the organization.

2. **Risk Assessment** — Management ascertains regulations for analyses of risks related to their achievement. A precondition to risk assessment is to identify the objectives, therefore, risk assessment involves the identification and analysis of relevant risks associated with achieving the set objectives. Risk assessment is a prerequisite for determining how the risks should be managed.

3. **Control Activities** — Any internal regulations, processes and procedures which help management in the implementation of their decisions. Controls are carried out within the entire organization, at all levels and in all functions. They include a range of activities such as approvals, authorizations, verifications, reconciliations, reports current activities, security of assets and segregation of duties.

4. **Information and Communication** — Organization of information flows, the collection, analysis, sharing of information.

5. **Monitoring** — Regular evaluation processes of the quality system elements, identifying deficiencies and their causes, correction of errors, monitoring of current activities.

COSO draws attention to the limitations of the internal control system, as well as on the roles and responsibilities of the parties, which affect the system. Restrictions include erroneous human judgment, misunderstanding of instructions, mistakes, misuse of managers, collusion, the ratio of costs and benefits. The COSO report identifies shortcomings as conditions of the system of internal control that merit attention. The statement of deficiencies shall be provided to the employee who is responsible for a plot, and to senior management. It is believed that the system of internal control is effective if all 5 components exist and function efficiently in relation to operations, financial reporting and compliance.

#### **THE EIGHT COMPONENTS OF THE COSO MODEL RISK MANAGEMENT**

Eight components of risk management include the previous five components of the conceptual foundations of internal control extended to meet the growing demand for risk management:

- Internal environment. The internal environment defines how risk is perceived by the employees of the organization, and how they may respond to it.

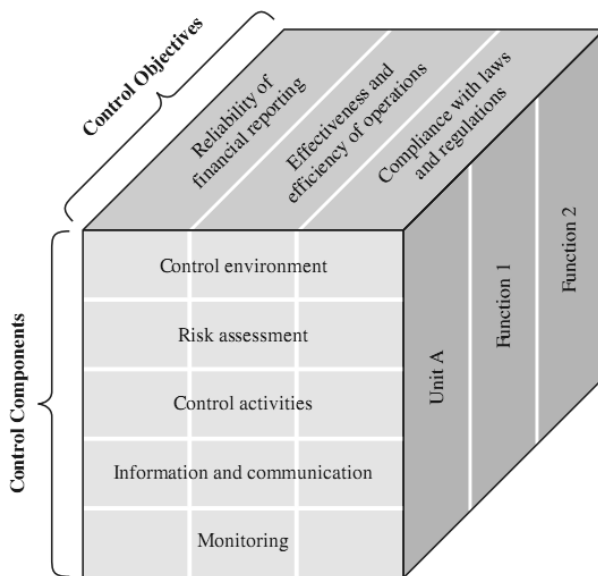


Figure 3. COSO Internal controls approach (COSO's cube).

The internal environment includes the risk management philosophy and risk integrity and ethical values, and also the environment in which they exist.

- Setting goals or objective setting. Goals must be defined before the start guide to identify events that could potentially have an impact on their achievement. The risk management process provides "reasonable" assurance that the company's management has properly organized process selection and formation of goals, and these goals are consistent with the organization's mission and the level of its risk appetite. Internal and external events affecting the objectives of the organization should be determined taking into account their separation on risks or opportunities. Opportunities should be taken into account by management in the process of developing a strategy and setting goals.

- Risk assessment. Risks are analyzed, considering impact and likelihood, with the aim which determines what actions they need to take. Risks should be assessed from the point of view inherent and residual risk. The management selects risk responses — avoiding risk, accepting, reducing, or sharing risk — developing a set of activities that allow lead identified risk in line with their risk tolerance and risk appetite of the organization.

- Control activities. Policies and procedures should be designed and installed so that to provide "reasonable" assurance that the response to emerging risks are provided effectively and in a timely manner.

- Information and communication. The necessary information should be determined, recorded and communicated in a form and timeframe that enable people to carry out their functional responsibilities.

- Monitoring. The whole process of enterprise risk management is monitored and if necessary it is adjusted. Monitoring is accomplished through ongoing management activities, or by providing periodic assessments.

COSO hoped that the conceptual framework of enterprise risk management will allow management of organizations to determine directly the relationship between the components of the risk management system and objectives that will satisfy the need for the introduction of new laws, regulations and even new requirements for registration of securities on stock exchanges and expected that it would receive wide recognition by companies and other organizations and stakeholders.

In May 2013 there were published new version of COSO model and its Internal Control-Integrated Framework (Framework). Below are the titles of the 17 principles of internal control by COSO's 2013 Framework, as follows:

#### Control Environment

1. Demonstrates commitment to integrity and ethical values.
2. Exercises oversight responsibility.
3. Establishes structure, authority, and responsibility.
4. Demonstrates commitment to competence.
5. Enforces accountability.

#### Risk Assessment

6. Specifies suitable objectives.
7. Identifies and analyzes risk.
8. Assesses fraud risk.
9. Identifies and analyzes significant change.

#### Control Activities

10. Selects and develops control activities.
11. Selects and develops general controls over technology.
12. Deploys through policies and procedures.

#### Information and Communication

13. Uses relevant information.
14. Communicates internally.
15. Communicates externally.

#### Monitoring

16. Conducts ongoing and/or separate evaluations.
17. Evaluates and communicates deficiencies.

Everyone plays a part in the internal control system. Ultimately, it is the management's responsibility to ensure that controls are in place. That responsi-

bility should be delegated to each area of operation, which must ensure that internal controls are established, properly documented, and maintained. Every employee has his own responsibility for making this internal control system function. Therefore, all employees need to be aware of the concept and purpose of internal controls. Internal audit's role is to assist management in their oversight and operating responsibilities through independent audits and consultations designed to evaluate and promote the systems of internal control.

Implementation of the internal control system required by COSO model for its effective functioning can have significant positive impact on the financial activities of the organization, as they provide management and owners the opportunity to focus on setting and achieving the company's goals (where to go, what and to whom financial services to offer taking into account inherent risks, etc.)

## CONCLUSION

The reliability of financial reporting is claimed to be a function of the effectiveness of a firm's internal control (PCAOB 2004). In this paper were used recently available data on the effectiveness of firms' internal controls coordinated by the Sarbanes-Oxley Act (SOX). We insist that if a firm has weak internal control, managers are less able to determine reliable financial data, and a consequence of these unintentional misrepresentations is that financial information is less reliable. Besides that, managers of firms with weak internal control can more readily override the controls and intentionally prepare biased accrual estimates that facilitate meeting their opportunistic financial reporting objectives.

Opponents of the law believe that the costs of compliance are too onerous for small businesses and it makes it difficult to realize benefits from the use. Supporters, on the contrary, believe that the law has increased the efficiency of small firms by reducing the overall riskiness of their activities and enhanced transparency.

This article is intended to help financial management to improve the business practices and processes, drive better performance, and transform the perception of the finance organization into that of a value-added key contributor to the company. For discussion, financial manager refers to anyone who is a CFO, controller, vice president of finance, divisional CFO, or a

manager who directly works for someone in such a position. This article focuses on the aspects of Sarbanes-Oxley and COSO that impact those employees working directly or indirectly for the CFO.. From the perspective of the COSO model, the main aim of the regulatory documents should be to reduce the level of systemic risks in the financial system of the country, by projecting mitigating risk controls at the level of the individual financial institution. Nobody can guarantee that once invented financial control authorities will actually buffer the impact of risk in the modern, highly variable conditions, if the system does not receive signals about the level of risk through feedback channels.

Identification of shortcomings or violations can be a signal of a possible problem related to the absence or improper operation of control, and this signal requires an in-depth analysis of the causes and understanding of the business process.

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