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THE DETERMINANTS OF THE ASYMMETRY  
IN CASH CURRENCY EXCHANGE RATES

Master's Thesis by the 2<sup>nd</sup> year student

Concentration – Corporate Finance

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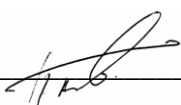
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**ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ  
ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ**

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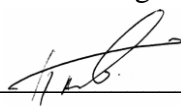
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THE MASTER THESIS**

I, Kondor Pavel Dmitrievich, (second) year master student, program «Management», state that my master thesis on the topic «Determinants of the asymmetry in cash currency exchange rates», which is presented to the Master Office to be submitted to the Official Defense Committee for the public defense, does not contain any elements of plagiarism.

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## Аннотация

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Цель, задачи и основные результаты	Цель: Выявить факторы, определяющие асимметрию в курсах наличного обмена валют. Задачи: Изучить существующие исследования в этой области и создать теоретическое обоснование асимметрии; Собрать данные для проведения анализа; Провести эконометрический и статистический анализ данных и сделать выводы. Выводы: Асимметрия связана с колебаниями на биржевом валютном рынке и с изменениями в спросе на обмен валют со стороны населения.
Ключевые слова	Валютный рынок, Розничный обмен валют, Микроструктура рынка, Асимметрия спреда Продажа/Покупка

## Abstract

Author	Kondor Pavel Dmitrievich
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Research goal, objectives and key results	Goal: Find the factors that determine the asymmetry in cash currency exchange rates Objectives: Study the existing academic researches in this field and create a theoretical framework; Collect the necessary data; Carry out statistical and econometrical analysis and make conclusions. Conclusions: The asymmetry is closely connected with FX market price shifts and trends and with the customer demand for currency conversion.
Keywords	FX market, Retail currency exchange, Market microstructure, Bid-ask spread asymmetry.

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## Introduction

The research focuses on the asymmetry of quotes or bid-ask spreads that the retail banks set forth to make the market of retail cash foreign currency exchange. The cash currency market is distinct from the regular interbank FX market. It is a dealer made market, where the retail banks act as the dealers. The bid-ask spreads are not always in equilibrium with the “major” rate (set either by the Central Bank or quoted from FX market). In other words, the medium point between bid and ask price is not always the same as the major quote from the FX market or Central Banks official rate. The research analyzes the asymmetry in the spread and suggests a model that quantitatively describes the asymmetry.

The asymmetry in percentage points was formulated as follows:  
$$\text{Asymmetry} = \frac{(\text{Ask Price} - \text{Major Rate}) - (\text{Major Rate} - \text{Bid Price})}{\text{Major Rate}} * 100\%.$$
 The ask price is the price the banks ask to exchange their currency for customers’ rubles, the bid price is the price the banks pay in rubles for customers’ currency, the major rate is the rate on the interbank market.

The banks and exchange agencies offer bilateral services in cash exchange: sell foreign for the domestic currency and buy foreign for the domestic currency. Furthermore, many retail banks also offer the cross currency operations (e.g. exchange JPY for CHF). The volume of the latter type conversions is much lower than the direct domestic-to-foreign and foreign-to-domestic operations. Limited information and low liquidity cause market inefficiencies and potential flaws in samples. To reduce biases and inconsistencies in the samples, only the direct operations will be considered in the research.

Retail exchangers have direct access to the global FX market. The population and small-to-medium enterprises usually avoid brokerage fees and have no direct access to the global FX market. The retail exchange houses create a separate retail foreign exchange market. It is closely connected to the regular FX, but has different buyers, sellers and specificities.

The market can be described as a dealer market with considerable conversion commissions. The base conversion rate is the rate quoted on the FX market. The rate for reporting and accounting for the financial operations is the official rate published by the Central Bank of Russia. The retail exchangers ask for a premium while selling and bid for a discount while buying foreign currency from its customers.

However, it turns out that these bids and asks are not ultimately fixed to the major rate: neither to FX market rates, nor to the quotes published by the central bank. Furthermore, these spreads even happen to be asymmetrical in respect to the major rates mentioned both Central Bank rates and FX quotes.

The main goal of the research is to analyze the asymmetry in quotations over the latest years for the set of banks. The result of the analysis is the econometrical model that explains the asymmetry in the bid-ask spread quotation in comparison to the “major” rate quotation.

The research uses a solid block of literature overviewing several aspects of the problem. Firstly, the main question is the FX market itself, therefore a significant part of the literature references is devoted to foreign exchange market for currency pairs either including Russian Ruble or not. The latter financial markets – though different nominally: neither USDRUB, nor EURRUB, have a lot in common. They all are integral part of a closely interconnected global FX market and therefore have similar peculiarities.

The second very important aspect of the research problem is the phenomenon of the dealer markets and the bid-ask spreads on the traded assets. It is crucial to get a good understanding of what drives the dealers on the market, when they set their rates. The rate-margins must neither be too wide to drive away the customers, nor too narrow not to lose profits. Therefore, another block of literature reference list is devoted to the bid-ask spreads on the dealer markets.

Thirdly, the question is how to obtain the data to be analyzed. Most of the banks store their quotes online but the format of the information makes it a complicated problem to download the data. Fortunately, there exist the quotation comparison web-services, which accumulate the exchange rates over time.

Finally, an econometric model was to be built. That is the reason why many research works with sophisticated models are included into the literature reference list. These works do not contribute to theoretical perspective in terms of analyzing the quotes, they rather support the practical aspect of analysis. They give useful insights into dealing with the data and discovering dependencies.

The data set obtained describes the quotes for EUR and USD against RUB in Moscow retail banks. These two currency pairs and, consequently four transaction types (buy and sell both currencies), were chosen because they happen to be the transactions with the highest volumes in comparison to other currencies exchanges (Central Bank of Russia, 2016).

The Moscow banks are chosen due to the two following reasons. Firstly, the number of banks in Moscow is the largest as compared to other cities in Russia (2). Secondly, Moscow is the center of Russian financial markets and taking Moscow banks as a benchmark means eliminating cash transportation costs from the cash currency retail prices. Foreign cash gets into Russia mainly through Moscow and delivering it into other cities requires additional spending which transfers into the commission for cash currency exchange: into the bid-ask spread.

The data set gives the quotes for the banks over the time period starting in early June 2014 and ending in March 2016. June 2014 is chosen as a starting point because it is the beginning of the negative trend in oil prices: the crucial factor for Russian currency. (8, 9, 10). March 2016 is the time when the final data mining started, after the literature analysis and model creation.

The data contains information for a large set of banks over a 2 year period. Some of the banks did not succeed in overcoming the crisis and disappeared. Other banks did not publish their rates regularly. These banks were eliminated from the analyzed data set, to eliminate inconsistencies in the sample.

Cash currency exchange market, although specific, has the traits of any regular market. Theoretical approach suggests there must be two main groups of factors determining the price (the commission in the terms of the retail market): supply and demand factors. The crucial supply factor is the ability of the retail currency exchangers get the currency. The banks offering cash currency exchange rates have access to global FX market. In other words, the global FX market and its trends influence the supply side significantly. The demand factor is the willingness of the citizens and companies to make exchange transactions. This consumer behavior may be an object for analysis as well. However, that question requires another separate research.

The econometrical model tries to take into account retail bankers' expectations of the future movements of the FX rates. The future price paths are often predicted by focusing on the past performance of the assets prices (in our terms, foreign currency). That is why the trend direction and velocity were chosen as the key indicators.

Open and close prices were chosen as proxies for determining the overall daily trends on the FX market. These or any other arbitrarily chosen parameters from the price-line appear to be representative indicators, because the market is highly liquid and does not have many outlying prices.

The supply side study shows that the asymmetry is stable when there is a stable trend on the market. When the foreign currency appreciates against Russian ruble, the ask commissions are

consistently higher than the bid commissions. Apparently, the banks take into account the direction of the FX price movements to fix profit for the future.

The two regression models describing the asymmetry on USDRUB and EURRUB bid-ask retail quotes were built. The independent variables for these models were the historic price movements over the latest trading sessions before each observation. The regression analysis has shown, that the asymmetry is closely related to the historic price changes. Furthermore, it turned out that the older the history the lower impact on the asymmetry is evident.

The demand side analysis has demonstrated strong correlation between volumes of retail foreign currency conversions and span of asymmetry in bid-ask spreads. When the population is buying more foreign currency than sells, the retail ask quotes are more distant from the FX rates than bid quotes.

The overall result of the research shows that there is a strong relation between the differences in premiums and discounts for selling and buying foreign currency and trends in FX market quotes. The changes in net retail currency conversion operations are also strongly correlated with the asymmetry. These facts support the hypothesis that the determinants of cash currency exchange rates asymmetry originate from supply and demand side factors.



## **Chapter 1. Research Background**

This chapter gives the academic description of the research. Its goal and objectives are stated. After that, the review of the research works on the relevant topics are presented and the research gap is demonstrated. The managerial application is also discussed here. The chapter continues with the research hypothesis and questions to be answered in the research. The conclusion of the chapter is the methodology of the research. The research techniques and methods are described in the end of the chapter.

### **Paragraph 1. Research Goal and Objectives**

The first issue to discuss is the goal of the research and its objectives. The goal is to analyze the quotes data, FX rates and market aggregated statistics to find the interdependencies that determine the asymmetry of the bid ask spreads that make of the cash currency exchange market. In other words, the goal is to find the factors for the rates asymmetry.

The research goal stated requires that a number of research objectives be stated and solved consequently. The research strategy is to prove the factors existence, spot the factors and analyze them in terms of degree of their influence.

The first objective of the research is to carry out a thorough study of the existing theoretical papers and empirical models concerning the topic of the research. This step is aimed at summarizing what has been done already and what is still needed to be done. This objective is fulfilled by studying the literature and publications in the academic journals. The information was outlined and summarized in order to give a brief overview of the research gap.

The second objective was to suggest a full set of factors which could potentially determine the bid-ask spread asymmetry. The extensive list was to be created in order to make tests for the elements of the list and determine their importance. To complete this objective, the theoretical literature and FX market analytics was used.

The third objective was to collect the data for the research. To analyze the asymmetry in cash currency exchange rates three milestone datasets were to be collected. These are the bid and ask quotes that the banks publish, the “major” rate data set for determining and calculating the asymmetry and the quantitative information about the influencing factors. The most difficult set to collect was the sample of bid and ask prices published by the banks. The banks publish the information of their historical quotes partially which made it a complicated problem to get a regular standardized dataset. The major

rates are freely available in the public access. The quantitative data about the influencing factors was also difficult to collect. In fact, a lot of specific factors that differ from bank to bank are impossible to collect.

Fourthly, the final objective was to make the data analysis and suggest a model that describes the asymmetry. This part of the research was structured according to the split of the overall influencing factors on the retail foreign exchange market. The demand – the population – side of the market was studied and the supply – the retail banks – was analyzed.

To sum up the overall composition of the research is the following. We start with the overview of the theoretical background in order to determine the unexplored fields in this topic. We then use the results of the theoretical studies to create a theoretical basement for the future analysis: we suggest a complete set of various potential factors that are connected to the retail FX market. The next step is to collect the extensive dataset: the retail banks bid-ask quotes, the major exchange rate for calculating the asymmetry and the quantitative information about the factors that influence the market. The final objective is to conduct a thorough analysis of the data and to determine statistically the tendencies and relations.

## **Paragraph 2. Theoretical review**

In this section, the existing research papers are discussed in order to describe the current situation in the academic research of the field of cash currency exchange rates. A number of academic research papers were studied and summarized. The short descriptions and the relevance of the papers are also discussed in this section. The summary of the existing findings is given. Most of the books, reviews and articles analyze the topic only in limited aspects, thus creating a research gap, which is covered in this work.

The research works that are related to the topic of cash currency exchange rates asymmetry focus on fundamental analysis of theoretical bid-ask spreads, empirical studies of interbank FX markets and on specific retail foreign currency markets characteristics. The works that are most relevant to our research of Russian retail foreign exchange market are stated in the list.

- (1) Copeland, T. E., & Galai, D. (1983). Information Effects on the Bid-Ask Spread. *The Journal of Finance*, 38(5), 1457-1469.
- (2) Saida Gtifa, Samir Maktouf and Nadia Labidi (2015). Dealer Behavior and Price Strategy in the Foreign Exchange Market: Evidence from FX Tunisian Market Dealer. *Journal of Business Studies Quarterly* 2015, Volume 7, Number 2.

- (3) Enn Liitra, Niina Vaiser and Katrin Rahu (2011). Systematic Differences of Retail Exchange Spreads in Some EU Counties: The Banks Against Financial Integration. Discussions on Estonian Economic Policy No. 2/2011.
- (4) Hussain S. (2011). The Intraday Behaviour of Bid-Ask Spreads, Trading Volume and Return Volatility: Evidence from DAX30. International Journal of Economics and Finance, Vol.3, No.1.
- (5) Kyle, A. S., & Obizhaeva, A. A. (2004). Market Microstructure Invariance: Empirical Hypotheses. SSRN Electronic Journal SSRN Journal. Available at SSRN: <http://ssrn.com/abstract=1687965>

The first article from the list is (Copeland and Galai, 1983). The authors focus on determining the bid-ask spreads in the organized dealer-made markets. They start with creating a framework for analyzing the spread: they estimate premiums and discounts from a profit maximization approach as a trade-off between liquidity and earnings. The key factor in adjusting the rates over time is the information: just as in the cash FX market making. The risk is in the information asymmetry. If the customer of the dealer gets the information about the changes in fair price of the traded asset earlier than the dealer, the customer can sometimes make an arbitrage and make the dealer lose on the transaction.

The approach of (Copeland and Galai, 1983) to the problem is to view the bid-ask spread as a call and put options combination: as a straddle. The exchange dealer gives the buyer the call option to call currency at the buy price (with a premium) and to put currency at the sell price (with a discount). The research creates a model for calculating the fair value of the bid-ask spread for the dealer. The research results are based on the pricing and, what is equal, bid-ask spread measured according to the geometric Brownian motion process.

This is a highly theoretical study. The authors focus on creating a model, which simulates the appearance of new relevant information effects on the prices and on the bid-ask spreads on the organized markets. The authors describe the assumptions they have for bid-ask spreads modelling. For example, they state why exactly bid ask spreads should be neither too short nor too narrow and offer the way to quantify these extremes and find the optimal trade off. The overly wide spread leads to losses of liquidity trader which would avoid greater commissions, while overly narrow spreads would let the dealer lose to better informed traders.

This paper is relevant for the research at hand. This fact can be backed by the argument that the bid-ask spread analysis is key for the asymmetry valuation. Before any asymmetry is analyzed one should first focus on the bid-ask spread itself to better understand the problem and to know the approaches already used in such analysis. Furthermore, the factors that determine the bids and asks are highly likely to influence them not equally in both directions in reality, thus creating asymmetry.

The next article to be described is (Gtifa, Maktouf and Labidi, 2015). This article analyzes the dynamics of Tunisian Dinar (TND) price in EUR before and during the period of Tunisian FX market turmoil. The authors test different factors influencing the exchange rate, such as trading volume, bid-ask spreads and volatility.

It demonstrates empirical research results. Although this article is about a market other than Russian currency: Tunisian Dinar, the circumstances are quite similar. The study considers the period of low volatility and a period of greater uncertainty and market turmoil. This reflects the Russian FX market situation.

This article is useful for the study of Determinants of the cash currency exchange rates asymmetry, because of several factors. Firstly, the research describes a method used for estimation of the implied volatility on the FX market. This is a helpful instrument to use in the research, because volatility and the way it is perceived by the dealers is could be among the key factors influencing the bid-ask spreads. Secondly, the methods used in the study (Gtifa, Maktouf and Labidi, 2015) were relevant for the research on Russian markets, because the circumstances in Tunisia were similar to what Russian market faced during the latest time. In other words, this piece of literature is of help to the research both from the technical point of view and as a theoretical foundation for the research.

(Listra, Vaiser and Rahu, 2011) is the third important research work to be studied. This article refers to the differences the same banking groups have in retail currency exchange spreads in various countries of presence. One of the important aspects the authors study are the factors influencing the spreads: macroeconomic issues and internal banking features of the banks' operations.

The article mainly focuses on the internal issues and discusses the price discrimination options the banks have in different countries of presence. This article is important for the research on cash currency exchange rates asymmetry, because it covers another aspect of the problem. The methods used in the study by (Listra, Rahu and Vaiser, 2011) are of greater importance as well as the outcomes of their study. They use such analysis instruments as regression analyses, statistical significance tests

etc. The results built are attributable to the European market and do not include the peculiarities of Russian market, however their methods are of great importance.

The authors consider the factors that influence the spread difference across the different countries in European Union. They elaborate on the spreads for the same large banking corporations. For this reason, the set of influencing factors is limited. They automatically exclude from the scope the factors that change across banks and which are caused by differences in internal procedures. So the result is more focused on the market itself and not overwhelmed by the different players' differences.

The outcome of the research (Listra, Rahu and Vaiser, 2011) is that the difference in the exchange rates commissions across different countries of EU are significant. The authors demonstrate that the spreads are narrower in the West-European countries and wider in the East-European. However, the authors do not provide a theoretical basement for this discrepancy. Furthermore, they do not discuss asymmetry in the rates.

The study (Hussain, 2011) analyzes the connection between the bid-ask spreads, trading volumes, returns and volatility. The author creates a model, which shows the connection between the key parameters of the market trading: spreads, trading volume and return volatility. The research studies regularities and analyses the degrees of significance for each parameter.

This work is not directly about the FX market, but it describes a fundamental work concerning organized dealer-made markets and is considered an important source of knowledge for creating an analytical model for the hypothesis testing. The paper is a powerful fundamental basement for the research on cash currency exchange rates asymmetry. This is a solid theoretical analysis of the dealer-markets and of the microstructures on such markets. This is, perhaps, one of the most relevant sources of information for the present research, because it gives a well-developed theoretical background and can be used as a basement for all the findings about the determinants of the asymmetry of the cash currency exchange rates.

The research paper (Kyle and Obizhaeva, 2004) provides a powerful fundamental basement for my research. This is a solid theoretical analysis of the dealer-markets and of the microstructures on such markets. This is, perhaps, one of the most relevant sources of information for my research, because it gives a well-developed theoretical background and can be used as a basement for all the findings about the determinants of the asymmetry of the cash currency exchange rates.

The overall academic findings relevant for the research describe the following aspects of the cash currency exchange rates asymmetry. The articles focus either on the spread size and its changes

across distinct markets, or on the parameters that explain the bid and ask quotes. (Listra, Vaiser and Rahu, 2011) as well as (Hussain, 2011) describe the spread size and the significance of the spread difference across different markets. The papers (Kyle and Obizhaeva, 2004), (Hussain, 2011) and (Copeland and Galai, 1983) analyze the theoretical influencing factors on the size of the bid-ask spread and discuss the potential determinants for the bid and ask quotes separately.

There have been no papers that treat the asymmetry as the major object of the research. Most of the papers focus on the size of the bid-ask spread, volatility and liquidity. They mention the asymmetry only indirectly; discussing that bid and ask prices may be sometimes determined by different factors. As the papers (Copeland and Galai, 1983) and (Hussain, 2011) suggest, higher volatility usually causes wider spreads. When the bid-ask spread becomes large enough in respect to the major FX quote the presence of the asymmetry becomes evident and rather significant.

### **Paragraph 3. Russian Foreign Exchange Market Overview**

According to Central Bank publications (Central Bank of Russia, 2016) and (9, 10) Russian foreign exchange market has become very volatile in the recent years. This was determined by the significant shifts in the oil prices and the volatility of returns on energy assets, tougher geopolitical stakes and partial isolation of Russia from the global financial markets.

The cash currency exchange market is separate from the interbank FX trading floors. The players and buyers, the liquidity and the speed of information flow are different on the retail exchange market. That is why the main characteristics of the market: the prices are different from the regular interbank FX prices.

Retail FX market for Russian population is extremely important. Russia, as well as many other developing countries has an unstable economy. The high risk of a local financial crisis and, as a consequence, currency devaluation makes people seek the more safe storage of value than the local unstable currency (Savenkov, 2015). One of the most straightforward of them would be the foreign currency in cash. The retail cash currency exchangers offer this service plentifully. That is why the study of this market is of high interest nowadays.

The Russian retail FX market can be described as a highly concentrated market in terms of currency choice. The most popular currency for conversion operations is the United States Dollar, around 73-75% of all operations. The second most popular one is Euro, 23-25 of the overall retail FX conversions. The other 1-2% account for all the other currencies against Ruble.

## Aggregated Supply of Foreign Currency, 2015

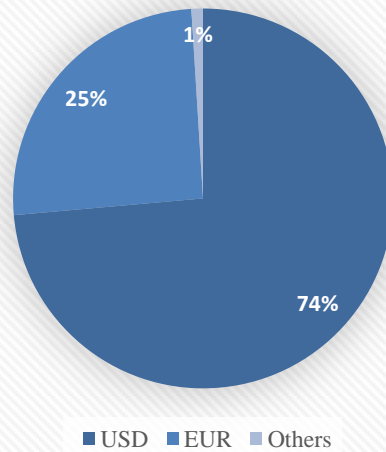


Figure 1. The relative portions of currencies in aggregated supply statistics for Russian retail FX market 2015. Most of foreign currency sold to the banks is in USD, 74%. The next most popular currency for sale among the population is EUR, 25%. Only 1% of all the foreign currency sold to the dealers were neither USD, nor EUR: all the other currencies.

## Aggregated Demand for Foreign Currency, 2015

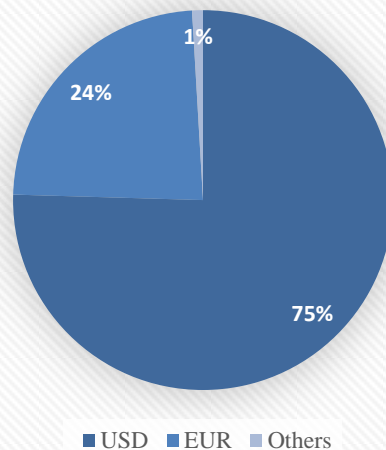


Figure 2. The pie chart of the portions in the aggregated demand for foreign currency in Russia 2015. Most of foreign currency bought from the banks is USD, 75%. The next most popular currency for purchase among the Russian population is EUR, 24%. Only 1% of all the foreign currency purchased from the dealers were neither USD, nor EUR: all the other currencies.

Recently there have been research papers, concerning the retail bid-ask spread size on the Russian market. However, the focus was once again more on the size of the spread, not on its shifts in relation to the major FX rates.

The asymmetry has become evident on the retail market in the recent years. There have been even cases, when the FX rate exceeded the ask prices and or sank below the bid prices (17). Apart from the single events of out-of-range retail FX quotes, in the existing terms of volatility on the market, some banks publish the consistently asymmetrical exchange rates.

These events have been taking place throughout the latest two years. However, they are out of the regular scope of the financial market analysis. In fact, the asymmetry in the bid-ask spreads has never been researched yet. That is why the topic is relevant, because it covers the research gap. The uncommon in regular circumstances events, which cannot be explained by the existing theories, have been present on the Russian retail foreign exchange market in the last two years.

The chosen research topic for the master thesis is “Determinants of asymmetry in cash currency exchange rates”. The topic is of high importance to the financial theory. Firstly, it will give an insight into the field of financial markets, which is rarely covered by academic research papers. Most researches of the financial markets are rather broad and do not focus on specific, narrow markets. Instead, the researches often generalize markets and describe certain relationships, which are similar on different trading floors independently of their particular characteristics. The research at hand will provide the analysis of several closely related markets with their peculiarities and will try to spot the factors, which are specifically important for this particular market. Secondly, the research will be up-to-date, thus relevant. The analysis will use the latest market quotes and trends and will base on the current factors influencing the retail FX market, thus making it useful.

#### **Paragraph 4. Theoretical Framework for the Research**

The general microeconomics theory states that a market is comprised of the two sides: the supply side and the demand side. These two parties interact and make their deals. The result of their interaction is the market itself with its natural characteristics: the volumes traded and the price on the market.

The analyzed market is the cash currency exchange market. We focus only on USDRUB and EURRUB operations because these are the most frequent ones and account for 95-99% of the market. The other currency pairs are much less liquid and require a separate research. There are 4 types of transactions we analyze: USD to RUB, RUB to USD, EUR to RUB and RUB to EUR. In all of the



operations, the participants are similar: the dealers or the retail banks with cash currency exchange services and the customers – the general population who want to convert their cash from one currency to the other. In this paper the dealers will be referred to as the supply side, or the market makers. The general public, who pays for the service of the exchange, will be called the demand side of the market.

In other words, the supply offers services of converting cash and has a range of four distinct services. The demand side purchases the services from the demand side and chooses the suitable service from the list of four direct and indirect transactions with EUR or USD against ruble.

The research of factors that influence the spread, or the price for the service, was structured in accordance with demand and supply market segregation. The both sides were analyzed in respect to the driving factors for them to enter the deals and to the means they use for the transaction. The set of potential factors, influencing the asymmetry was created.

The market makers, or the supply side, operate in the following way. They buy the foreign cash currency from the population with a discount and sell it to them with a premium. They clear their balances on the interbank FX market, which is much more liquid. The cash FX market is much less liquid and informationally-efficient, that is why the different prices are available at different banks at the same time. At the same time the spread should not be too wide to cast away the customers. In other words, the two main factors that are important for the dealers are the interbank FX quotes, because they make profits by adding margins to it and the competitive factors, which determine the number of transactions a market maker services (Listra, Vaiser and Rahu, 2011).

The retail FX market is heavily dependent on the interbank FX market. That is why this factor influence will be primarily analyzed. The rivalry across retail banks issue includes not only competitive pricing, but also differentiation strategies and locality factors. These issues are important to the pricing, but are out of the scope of this research, because they need to be studied from bank to bank individually. This research however is focused on the industry analysis and on the peculiarities that are attributable to most of the players on the market.

As for the demand side, there are two crucial reasons for the public to buy or sell the foreign currency: the first is the need to make transactions with foreign parties. The customers buy foreign currency to pay for something abroad or sell foreign currency to convert their proceeds from foreign parties into rubles. The second important reason is the expectations of inflation and/or devaluation. In the periods of local currency depreciation, the public seeks a safe haven to protect their savings. When

ruble appreciates, the population decides to take advantage of it and buys rubles back for foreign currency (15).

The first option, transactions with foreign parties, is assumed to happen on a rolling basis, without any significant shifts over time. Except for the seasonal summer shifts in demand for foreign currency, which occur due to the vacation schedule and travelling. The changes in consumer behavior during ruble appreciation or depreciation against the basket of American and European currencies are also the important factor for the research of the asymmetry on the retail FX market.

### **Paragraph 5. Managerial Application**

As far as managerial applications are concerned, the research sets its goal in creating an econometrical model for calculation of the fair value of the fee for cash currency conversion: the bid discounts and ask premiums. The research is aimed to help the retail bank managers, who are responsible for setting up the daily bid and ask rates.

In the periods of low volatility and of the stable currency quotes on the interbank markets, the retail FX market is in equilibrium and the competition among banks drives the prices to the level of transactional expenses (Savenkov, 2015). During the calm periods, the banks get their ask price by adding a transaction fee and a margin to the interbank FX rate and get their bid prices by subtracting instead of adding.

On the other hand, the FX market turmoil drives the spreads wide. The retail bank manager responsible for retail FX transactions should not simply add for ask and subtract for bid the transaction costs and margins to the base rate, but also consider the potential movements of the interbank FX price and the existing rivalry. So the bank manager has to take into account profitability, risks of sudden currency shifts and of the competitors, who can offer better prices. The bankers have to find a tradeoff between casting away the customers by the enormous bid-ask spread and losing money in case of a sudden price shift. The potential remedy to this problem is to establish an asymmetrical pricing for selling and for buying. This allows the banks hedge their risks and still lets them stay competitive.

There are models that describe the dependence of the spread on the market volatility (Gtifa, Maktouf and Labidi, 2015) and (Savenkov, 2015), however, none of them describes the amount of the asymmetry. The current research gives a model that can be used by a bank manager as a benchmarking tool. The bank manager will be able to see the asymmetry amount that theoretically corresponds to the current market conditions. The bank manager will thus be able to compare his FX pricing to the

general market pricing to see the competitiveness level. Furthermore, the managers will be able to analyze their internal mechanisms for setting the quotes.

### **Paragraph 5. Research Methodology**

The research is focusing on the empirical sets of data and gives a description of the determinants that influence the cash currency exchange spreads on the specific market. That is why the results are not aimed to be universally applicable for cash currency markets but work for the particular circumstances at hand. The research methodology corresponds to the goal and objective stated and is designed to get practical numerical solution to the problem stated. Therefore, the main research method used is data collection and data analysis. The analysis of the data is both quantitative and qualitative.

First, the description of the quantitative analysis methods will be given. At the first stage, the data about the banks' exchange rates was collected and primarily analyzed. Here the sample visualization methods were used (bid-ask spreads over time visualization, frequency histograms, volatility graphs). This kind of analysis helps to check for any peculiarities that might lead to a conclusion of one or the other factor may potentially be the determinant of asymmetry. Then the descriptive statistics were calculated for the periods, where the specific patterns are present. The results of these calculations lead to a number of formal conclusions. The next stage was running the regression models and analyzing the levels of significance for the different factors. The data set in the analysis is a list of quotes that different banks publish over almost two years. For each set of quotes, there are two corresponding navigators: the date and time of publishing the quote and the publishing bank, In other words, the data is both cross-sectional: ~200 banks, and time-series: there is data for almost every day from June 2014 till March 2016. Therefore, panel data analysis toolset was exploited. The data set was tested to have random or fixed effects. Hausman test suggested, the data should be analyzed with a fixed effects approximation.

Second, the qualitative analysis of the data itself and of the findings of the quantitative section was performed. The qualitative analysis is the general analysis of the data in accordance with theoretical frameworks. The key influencing factors from theoretical perspective have been discovered and structured. The formalized groups of factors were then explained in accordance to the economical and financial theory. Then their influence and the degree of their influence was summarized too in order to give a formal output of the research applicable to the banks management.

The previous studies that use the methodology described above are the articles mentioned in the literature review section of this research paper. Especially those, which are highly empirical studies, because their goals are rather close to what is dealt with in this research. These studies are (Gtifa, Maktouf and Labidi, 2015), (Listra, Vaiser and Rahu, 2011) and (Hussain, 2011).

All in all, in the first chapter the holistic analysis of the research was presented. It was shown that there is a research gap to be covered by the research. It was discussed that the research goals and objectives are relevant to both academic research in the field of finance and to the managerial application of the outcomes of the research. The literature review was given in order to provide an overview of the existing situation in the field of the research and to show what had been covered so far by researchers. The methodology section elaborated on the ways to solve the problems. The research goal is to determine the factors to explain the asymmetry in cash currency exchange rates. The literature used concentrates on the FX market analysis and on the market study methods. The major methods are the statistical data analysis methods and the regression analysis methods.

## **Chapter 2. Dataset Overview**

This chapter provides an overview of the data set used in the research work. Due to the volume of the data set, only the key information of interest will be summarized in this chapter. The following features of the data set will be disclosed: the origin and the description of importance of each of the variables, the explanation of the frames used to limit the information needed, the key statistics and further limitations imposed on the data set and the data required for the deeper research will also be discussed here.

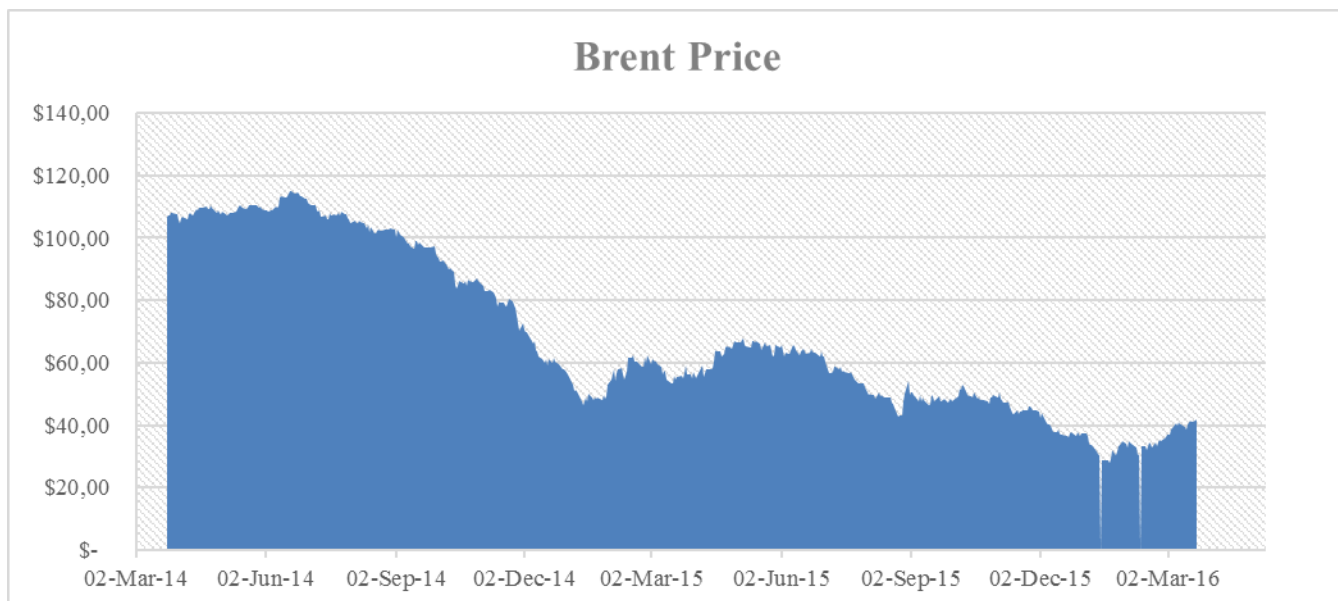
### **Paragraph 1. Dataset Origins**

To analyze the problem of the asymmetry determinants, four major sets of data were used. These data sets describe the asymmetry and the influencing factors, suggested by the theoretical analysis:

- (1) The cash currency exchange rates published by the banks,
- (2) FX market quotes for EUR/RUB currency pair,
- (3) FX market quotes for USD/RUB currency pair
- (4) Russian Central Bank statistics of the shifts in demand for foreign currency among Russian population.

The first dataset was treated as the dependent variable set, while the latter three sets from the FX market and from Central Bank of Russia were used as the independent sets of variables.

In accordance with (Savenkov, 2015) during the low volatility periods, the spread is determined mainly by the internal transactional costs. The spreads are narrow and the asymmetry is not significant. Starting from the time, when oil prices peaked, the volatility increased, the ruble depreciation trend became strong and the asymmetry emerged. The time period chosen for the research starts in the end of May 2014 and ends in the end of March 2016. This time frame is the most descriptive, because it starts before the oil market turmoil (see Figure 3) and spans until the latest dates.



*Figure 3. Historical Brent Oil prices. The historical prices graph shows the evolution of the oil prices over the latest 2 years. Oil prices and Russian Ruble rates are highly correlated. With the fall in oil quotes Russian Ruble market turmoil started. This is the most interesting period for research, because of the considerable bid-ask spreads set by the retail banks: the scope of the spreads demonstrated the asymmetry. The observation set for this research begins in summer of 2014, when the oil prices were high and stable (8).*



*Figure 4. Historical USDRUB and EURRUB quotes. The graph shows the appearance of the positive trends in US Dollar and Euro direct quotes in the summer 2014. This is the beginning of the FX market turmoil, the most interesting period for the research, because the huge changes in the market rates made the retail bankers impose high bid-ask spreads for cash currency conversion transactions (9, 10).*

Oil price turmoil began in summer 2014. The high correlation of oil prices and Russian Ruble prices in US Dollars and in Euros lead to the turmoil in Russian FX market. The core shifts in the FX market made the retail bankers worried about their profits and they started adjusting to the changing FX quotes. High volatility on the market has led to the high fees on cash foreign currency exchange transactions. That is why this period is the most interesting for the research.

## **Paragraph 2. Variables' Description**

The problems to be solved by data set collecting were the following:

- (1) In order to analyze the retail banks' cash currency exchange rates, the rates must found first.
- (2) To analyze the asymmetry, one should determine the central rate to calculate the asymmetry.

(3) Influencing factors study requires having the data for a quantitative description of these factors

The problem (1) stated above: collecting the banks' cash foreign exchange rates [8], was the most challenging task to carry out. The first and the most straightforward way to collect the information was to go to Central Bank web page to get a list of banks offering cash currency exchange services. Then, using the list of the banks, go to their respective websites and collect the data over the last years. Here the main hindering obstacles appeared.

Most of the banks do publish their rates publicly on their websites. However, the data on the websites is difficult to download. That is to say, the information is publicly available and one can read it or otherwise get the information on whichever date one desires. Nevertheless, it is practically impossible to download the data for a deep quantitative analysis.

For example, PAO Sberbank of Russia on its web site (12) has an archive of the foreign exchange rates. Each update is offered in a separate excel file available for downloading. PAO Sberbank of Russia updates its rates several times a day, which makes it necessary to download and aggregate at least a thousand of separate files only for Sberbank. Another negative example is Russian Standard Bank. This bank also stores the information publicly, but the format of a daily updated graph with historical rates (13).

The solution to this problem was to use the online foreign exchange rates aggregators platforms. Their websites, for example (11) is analogous to skyscanner.com for airlines tickets or booking.com for hotels. The service gives comparison of the banks exchange rates and stores the historical rates in a table format. The rates downloaded from the website (11) were used as a primary source of data about the market makers' quotes.

However, the website (11) is not the official source of information. For this reason, the data obtained required checking for inconsistencies with the official rates, published by the banks themselves. Checking the whole data set was impossible due to the same reasons as collecting the whole set. There have were approximately 170 thousand of observations, so direct checking would be also impossible. Therefore, the sampling method was used. Following the sampling method, we took arbitrarily chosen observations and compared the observations with the official information from the official banks websites. Some banks store the historical data; the other banks do not, so for the banks without the historical rates, the latest rates were checked. It turned out that all the banks checked did publish the same quotes as the aggregator (11) claimed.

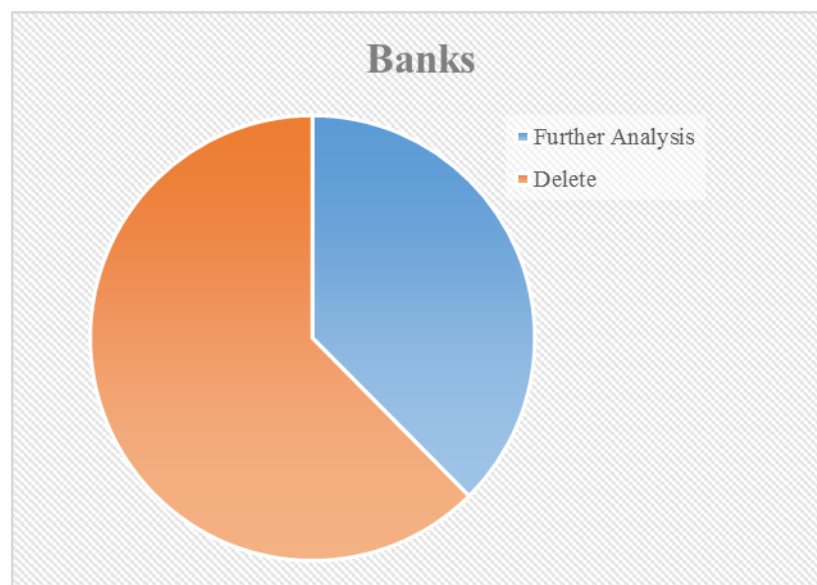


### Paragraph 3. Dataset Adjustments

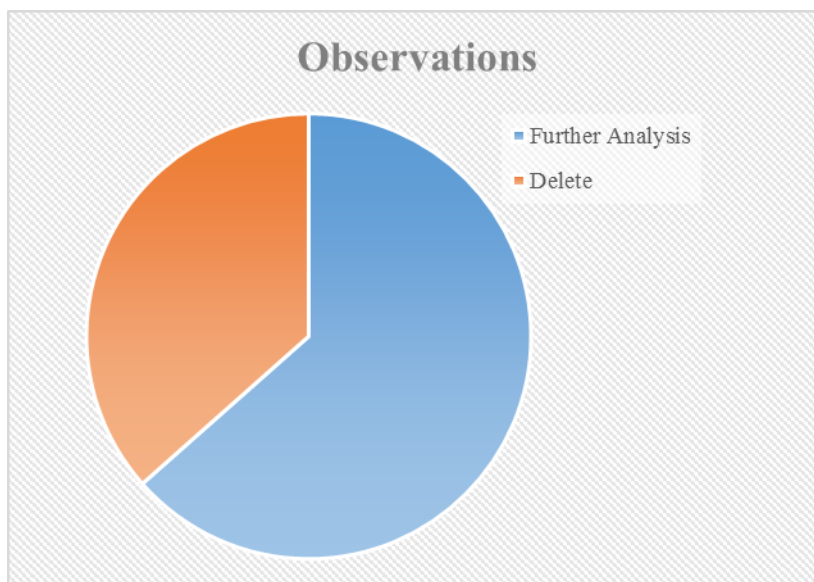
During the data checking, the next problem aroused. Not all of the banks could be checked: some of the banks lost their licenses over the course of the dataset period and their official webpages lost their authenticity. That is why a number of banks had to be excluded from the list.

There has been a total of 197 different banks in the data set: 197 banks published their retail foreign exchange rates during the period from June 2014 till March 2016 in Moscow. However, not all of the banks published their results regularly and during the whole time period. That is why 123 banks from the initial list were excluded from the further consideration. The full list of the banks and the list of the excluded banks can be found in the appendix 1.

In order to get the most relevant banks for further consideration, Pivot table technology in MS Excel was used. The pivot table was created. The major column was with the bank names and the two supporting columns were with the first and last publishing date of cash currency conversion rates. If the first and last rate publishing dates were not within a week from starting and ending period, it was assumed that the bank was either inactively participating in retail foreign exchange or was not operating during the entire period of the research.



*Figure 5. During the crisis period Russian banking sector underwent serious changes. Many banks lost their licenses or went bankrupt. The research used the quotes only of those banks, who have been publishing their rates consistently throughout the time of analysis without periods of no rates updating. The pie chart demonstrates, that of 197 bank that were publishing retail FX rates, only 74 did it uninterruptedly.*



*Figure 6. This pie chart shows that the excluded 2/3 of the banks accounted for 1/3 of all the observations. This supports the argument that the excluded banks did not publish their retail FX rates regularly. Apparently that means these banks were not engaged into cash currency exchange operations.*

After the list of banks was narrowed down approximately threefold, the number of observations decreased approximately by 35% (from 170 thousand to 109 thousand of observations). This result supports the idea of decreasing the data set. The large number of banks (123) that did not meet the requirements did not publish their quotes regularly.

As the adjusted data set of the bank exchange rates was obtained, the next problem (2) had to be solved: how to determine the asymmetry in cash currency exchange rates. The asymmetry consists of two parts. One is the set of rates themselves. The other is the benchmark, which serves as a comparison milestone for the rates.

The first idea was to use the officially published by Central Bank of Russia foreign currency rates. The idea seemed perfect. However, it turned out that the Central Bank Rates are published for other than transaction making purposes. These rates serve as an accounting reference, but not as the real exchange rate. For that reason, another rate was taken.

This alternative rate is the rate used by the banks in their operational transactions: the FX rate from the interbank market. The retail banks make conversion operations on the FX. At the same time, they buy and sell cash currency on the retail market, thus becoming intermediaries between the two markets. That is why not the Central Bank official rate, but the FX market rates were used.

The interbank FX in fact is also a dealer made market and there are the bids and asks as well. However, the bid-ask spreads on FX are hundreds to thousands times smaller than the retail spreads. These two magnitudes are incomparable and thus the interbank FX spreads can be ignored, by using the mid quotes only. This was what had been done and that is why the FX rates for EUR/RUB and USD/RUB currency pairs were taken (9, 10).

When the data from the FX market was collected, the asymmetry was determined as follows. The discounts to buying foreign currency from customers was determined to be open price on that day on the MICEX stock exchange minus the bid rates set by the banks: Bid. Discount = Open. FX – Bid. The premiums to sell foreign currency to customers was determined as the ask rate published by the bank minus the open price quote from the MICEX Moscow stock exchange: Ask. Premium = Ask – Open. FX. Then the absolute asymmetry equals the value of the ask premium minus bid discount: Asymmetry = Ask. Premium – Bid. Discount. The price of USD and EUR in rubles changed significantly over the period of observations. Therefore, it was considered more accurate to use a relative scale to describe the asymmetry in percentage points. The base for the percentage asymmetry calculation was the open quote on the FX market:  $Asymmetry = \frac{Ask.Premium - Bid.Discount}{Open.FX}$ .

Overall, the asymmetry formula takes the following form:

$$Asymmetry = \frac{(Ask - Open. FX) - (Open. FX - Bid)}{Open. FX}$$

The results of the descriptive statistics present the general information about asymmetry in the sample of banks that published the rates regularly.

<b>Asymmetry EUR</b>	
<b>Mean</b>	<b>0,34%</b>
Standard Error	8,64E-05
<b>Median</b>	<b>0,26%</b>
<b>Standard Deviation</b>	<b>2,89%</b>
Sample Variance	0,0008
Kurtosis	21,83818
Skewness	1,561392
<b>Range</b>	<b>89,98%</b>
Minimum	-25,98%

Maximum	64,02%
Count	111982

Figure 7. Descriptive statistics for the asymmetry in EUR against RUB rates. The central tendency results are close to zero, however the standard deviation is large as well as the range of the sample. The offset of positive and negative asymmetry periods.

<b>Asymmetry USD</b>	
<b>Mean</b>	<b>0,67%</b>
Standard Error	0,01%
<b>Median</b>	<b>0,50%</b>
<b>Standard Deviation</b>	<b>4,94%</b>
Sample Variance	0,0024
Kurtosis	24,46
Skewness	2,39
<b>Range</b>	<b>104,14%</b>
Minimum	-29,16%
Maximum	74,98%
Count	109760

Figure 8. Descriptive statistics for USDRUB rates. The central tendency results are close to zero, however the standard deviation is large as well as the range of the sample. This could be explained by the offset of positive and negative asymmetry periods.

The descriptive statistics tables for both US Dollar against Ruble and Euro against Ruble show rather similar conclusions. On average the bias for both currency pairs is directed towards the ask price: the ask price premium is generally higher than the bid price discount. However, the ranges of the asymmetries are very broad and cover both directions. Although the mean and median are rather small, the standard deviations and range demonstrate the existence of the nonzero asymmetry in the sample. The explanation is that there are periods of positive and of negative asymmetry on the market. These two types of periods offset each other, bringing the total average close to zero.

The central tendency indicators imply the greater positive (towards the ask price) asymmetry in the dollar quotes. However, the standard deviation measures are also higher for dollars. This is

determined by the greater volume of USD/RUB transactions as compared with EUR/RUB. Larger volumes of transactions correspond to the greater demand for the product, greater margins: bid-ask spreads and greater volatility consequently.

As the descriptive statistics tables show, the asymmetry exists and needs to be explained. The last question (3) for data collecting is about the influencing factors. It is desirable to have data about all the possible factors that could determine the asymmetry.

As discussed in the first chapter, the retail cash foreign exchange is a market with the buyers and the sellers. When an active market exists, then there always are the demand and supply sides, both having their needs and being subject to a range of factors. We structure the potential determinants in the following way. The supply side is directly related to the FX market price movements and to the market competitive factors. The latter are specific for every market maker and are not considered in this research. So the FX market data becomes the source of the information for the supply side analysis. The demand is driven by the transactions with foreign parties and by the need to store value in foreign currency. The transactions with foreign parties are impossible to account for in this research. These both factors are included into the statistics by Central Bank of Russia. The statistical report contains information about the volumes of the cash FX conversions in Russia on a monthly basis.

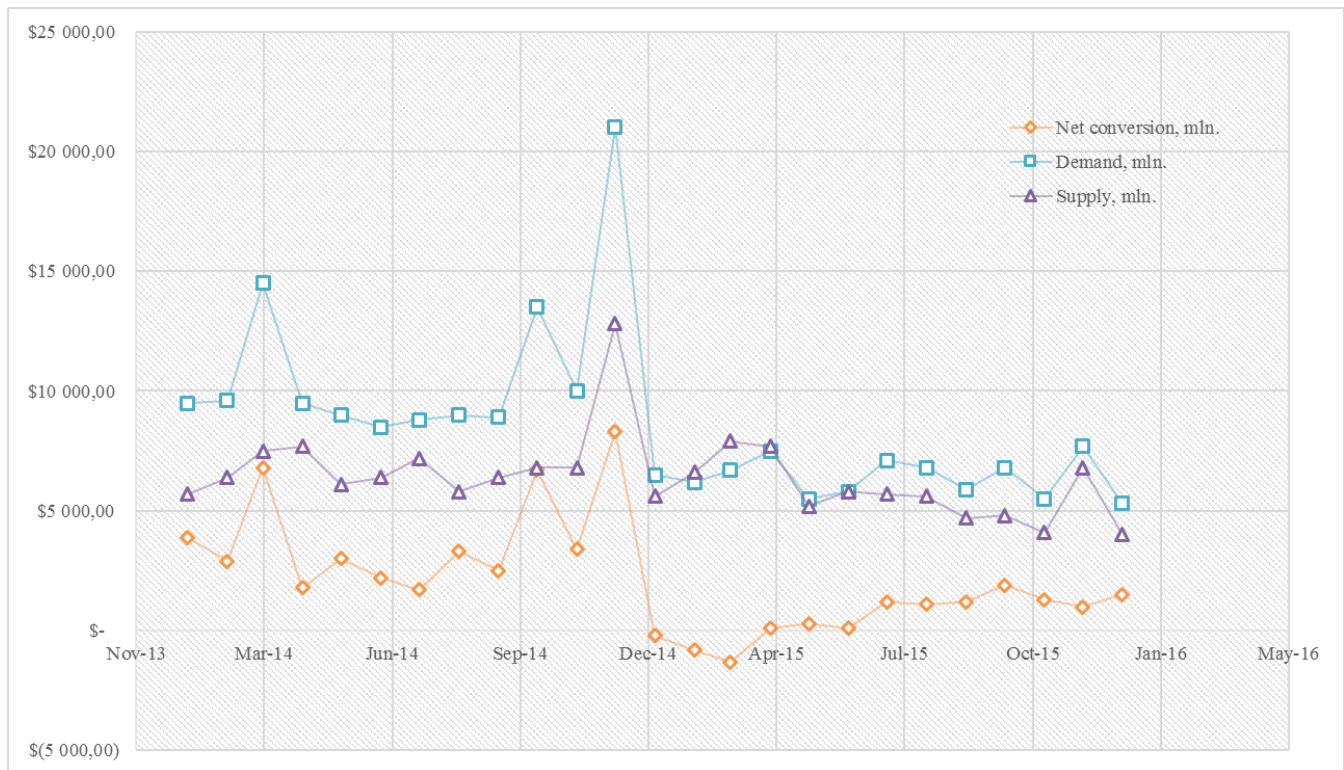


Figure 9. Central Bank of Russia monthly aggregated statistics of total conversion operations made by individuals. The total numbers are in US Dollars millions. The graph shows that most of the time the net conversion operations account is positive. The population in general buys more foreign currency than sells.

The Central Bank Statistics is presented on the figure above. The monthly sums of purchased and sold foreign currency in US dollars mln. demonstrate increased volume of FX market activity in December 2014 during the FX crisis and market panic. The seasonal shifts in demand happen primarily in the middle of Spring and in the middle of autumn.

To make a conclusion, the second chapter gave an overview of the data set. Such issues as timing and key data sources were described. The challenges and hurdling circumstances in collecting the data were discussed and the solutions to the problems were described. The outcomes of the dataset adjustments were the decrease of the number of observations and number of retail banks offering cash currency exchange services.

The asymmetry itself was determined as the difference between ask premiums and bid discounts divided by the open price on the MICEX USDRUB. The relevant descriptive statistics and the conclusions drawn from the statistics were stated. The major fact is that the asymmetry exists and the bias is aimed at the increased ask prices as compared to the FX market. Furthermore, the range of

the asymmetry is surprisingly high. Sometimes the asymmetry gets as great as approximately 30% of the FX price. The potential influencing factors were preliminarily analyzed and some conclusions were made. The supply side factors were analyzed with historical interbank FX quotes. The demand side factors were studied with Central Bank statistics for aggregated monthly customer spending on retail FX transactions.

## Chapter 3. Dataset Statistical Analysis

This chapter provides the overview of the analytical research steps. The analysis was structured in the following way. At first we study the asymmetry in general and try to analyze its peculiarities. Then we switch to the factors datasets analysis and making conclusions. We find out there are strong similarities in the datasets for the asymmetry and of the factors. Then we arrive at studying how the datasets are related to one another. Finally, we create a focused model that quantitatively describes the asymmetry.

### Paragraph 1. Asymmetry Analysis

As the descriptive statistics tables state, the asymmetries on average are positive and are biased towards the ask quotes. The asymmetry is not exclusively positive and has high standard deviations. The maximal ranges of the asymmetries in samples are around 90% for Euro and around 104% for US Dollars. This suggests that the asymmetry direction changes over time making it close to zero on the cumulative basis. In order to visualize the asymmetry two graphs are given: one for the asymmetry in US Dollars against ruble quotes and the other one for Euro against ruble prices.

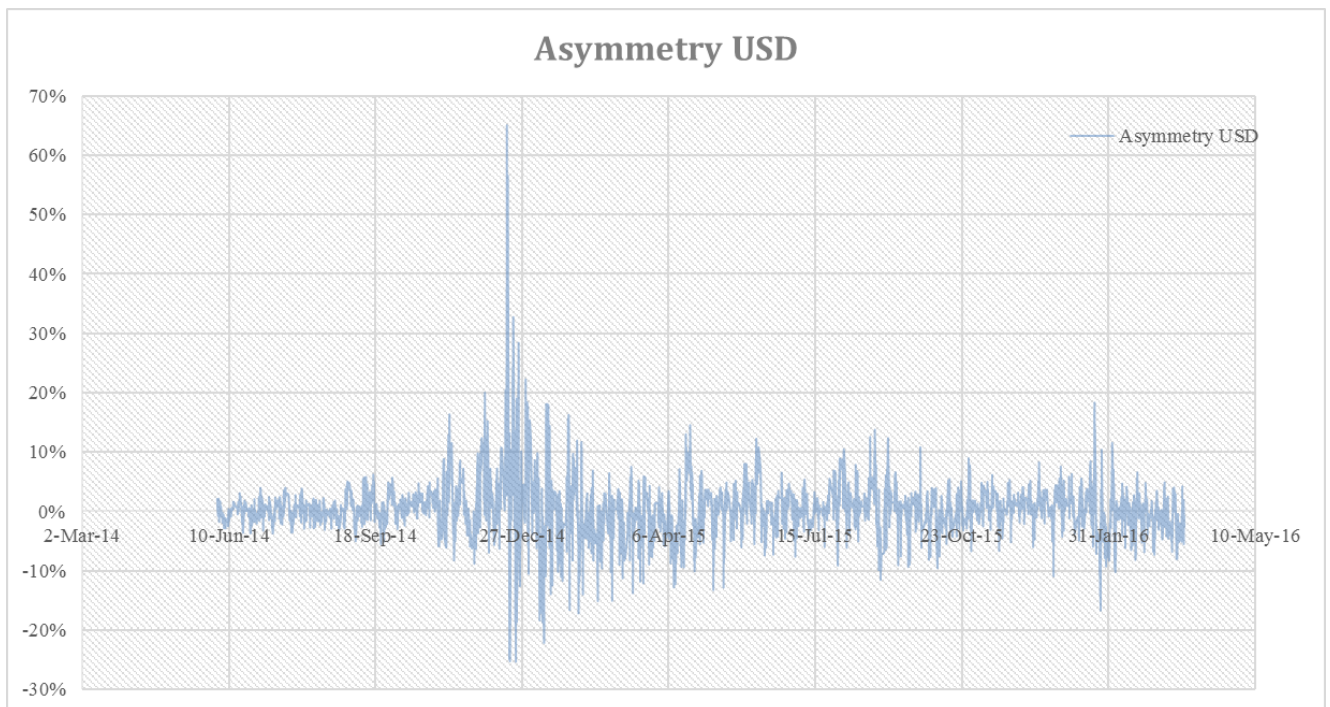
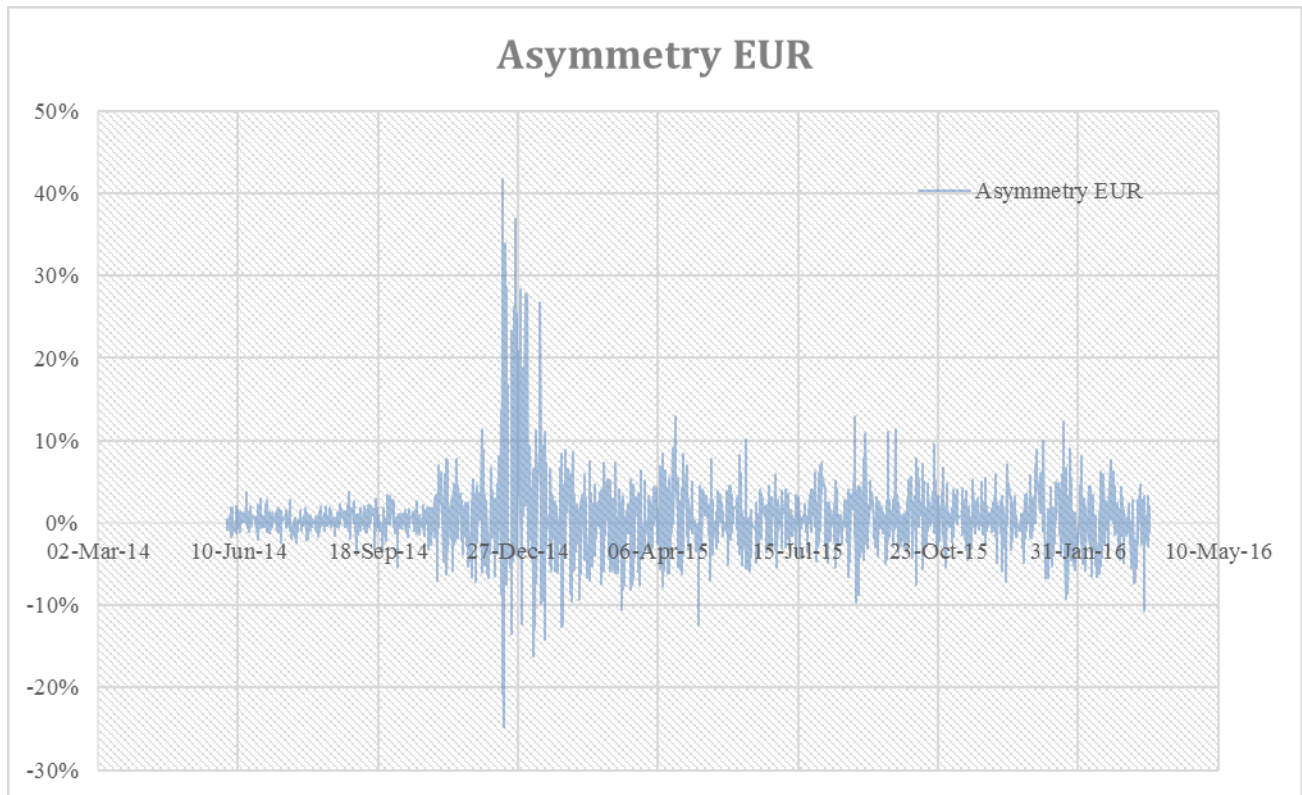


Figure 10. The time series graph of the asymmetries in USD/RUB retail prices. The graph shows high volatility and period of positive and negative medians.





*Figure 11. The time series graph of the asymmetry in EUR/rub retail prices. The graph shows high volatility and period of positive and negative medians.*

The visual analysis suggests the asymmetry takes place on a regular basis. Either the ask premiums or the bid discounts are greater during the certain time periods. The positive asymmetry directed at the ask premiums implies that that higher demand of the population for cash Dollars and Euros outweighs the supply of it.

### **Paragraph 2. Determinants Analysis**

In this section, the analysis of the influencing factors dataset is described. We begin with the supply aspect of our investigation and study the behavior of the FX market indicators during the observation period. Then we turn to the demand aspect and analyze the statistical data over the period. Then we compare the results of the analyses of both aspects and make inferences about that.

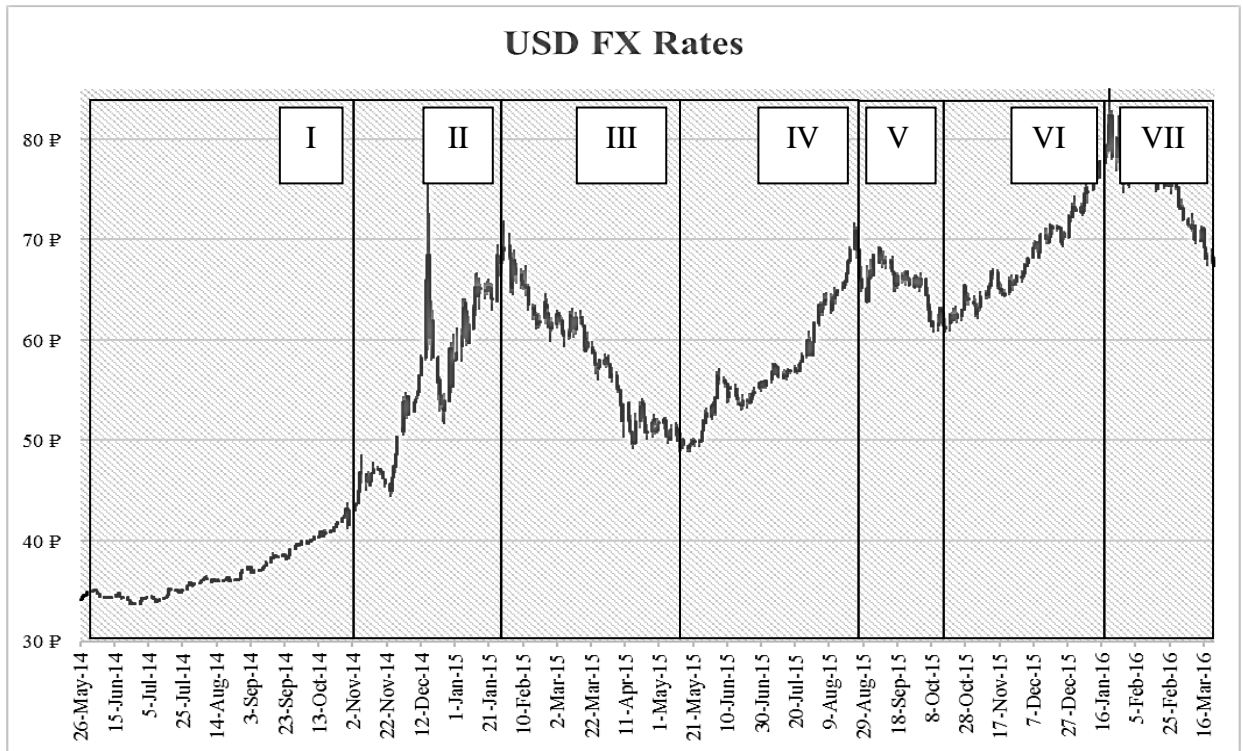


Figure 12. The candlestick chat of USDRUB instrument. The chart shows seven distinct areas with different price behavior. These areas are market with roman letters from one to seven. The periods differ in the trend direction and price volatility.

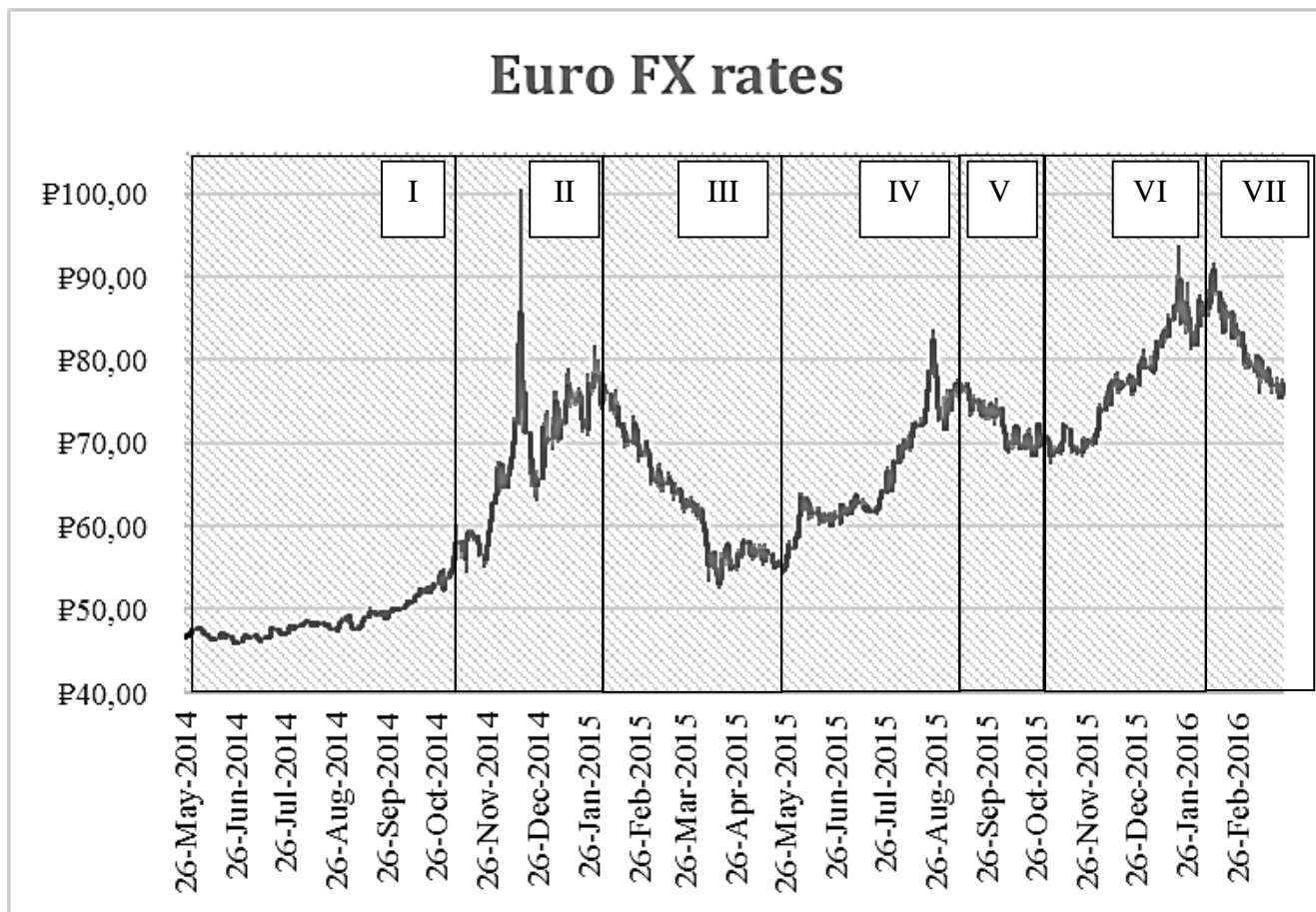


Figure 13. The candlestick diagram shows the behavior of EURRUB instrument on the interbank FX market. The graph shows seven different periods of price movements. They include Euro appreciation, depreciation and stagnation. The periods are different in terms of their volatility or trend direction.

The supply aspect analysis leads us to a set of seven periods with distinct price behavior patterns. The first period starts in June 2014 with the beginning of the observations. It lasts till the first of November 2014, when the first FX market panic signs appeared. This period can be characterized as a smooth uptrend with relatively low volatility. The period number two starts on the 1<sup>st</sup> of November 2014 and spans over the FX market panic period through to the end of January 2015. This period demonstrated high volatility and steep trend of ruble depreciation. Third period begins in February 2015. This was the first reversal trend. Ruble started appreciating. The appreciation was volatile and lasted till the mid May 2015. Throughout the Summer 2015, the period IV, the ruble went down again. The volatility was lower that before, but still greater than during the first period. In September – October 2015, section number V, there was a medium-volatile side trend present, which

turned to strong upsloping trend in the period VI: from mid October 2015 till mod January 2016. The final period, section number VII demonstrated a downsloping trend with high volatility.

Both instruments, USDRUB and EURRUB, show almost identical performance. The more accurate analysis results are presented in the tables below.

<b>USDRUB Quotes Analysis</b>					
	Beginning of Period	End of Period	Visual Characteristics	Volatility average: (High-Low)/open	Monthly Change over the period
<b>1</b>	1-Jun-14	1-Nov-14	Smooth&slow uptrend	1,07%	4,64%
<b>2</b>	1-Nov-14	31-Jan-15	volatile uptrend	4,95%	20,47%
<b>3</b>	1-Feb-15	20-May-15	Volatile downtrend	3,12%	-7,88%
<b>4</b>	20-May-15	31-Aug-15	Medium-Volatile uptrend	2,39%	9,46%
<b>5</b>	1-Sep-15	15-Oct-15	Medium-Volatile stagnation	2,37%	-1,27%
<b>6</b>	16-Oct-15	20-Jan-16	Medium-Volatile uptrend	2,07%	7,64%
<b>7</b>	21-Jan-16	22-Mar-16	Volatile downtrend	2,74%	-5,54%

*Figure 14. The table summarizes the analysis of USDRUB quotes from the MICEX market. There are 7 periods that are characterized by volatility, direction and steepness of the trend.*

<b>EURRUB Quotes Analysis</b>					
	Beginning of Period	End of Period	Visual Characteristics	Volatility average: (High-low)/open	Monthly Price Change over the period
<b>1</b>	1-Jun-14	1-Nov-14	Smooth&slow uptrend	1,13%	2,03%
<b>2</b>	1-Nov-14	31-Jan-15	volatile uptrend	5,26%	14,95%
<b>3</b>	1-Feb-15	20-May-15	Volatile downtrend	3,10%	-8,12%
<b>4</b>	20-May-15	31-Aug-15	Medium-Volatile uptrend	2,71%	9,74%
<b>5</b>	1-Sep-15	15-Oct-15	Medium-Volatile stagnation	2,71%	-1,58%
<b>6</b>	16-Oct-15	20-Jan-16	Medium-Volatile uptrend	2,38%	7,66%
<b>7</b>	21-Jan-16	22-Mar-16	Volatile downtrend	3,25%	-5,20%

*Figure 15. The table summarizes the analysis of USDRUB quotes from the MICEX market. There are 7 periods that are characterized by volatility, direction and steepness of the trend.*

If we compare the FX market quotes and the asymmetry chart period by period, we see there is a certain pattern. The steeper upsloping trends take place at the same time periods as the positive median asymmetries. The downsloping trends occur simultaneously with the negative average asymmetry periods.

## **Chapter 4. The Results**

This chapter presents the results of the research. The statistical analysis and the econometrical model are provided here. After that, the conclusion is drawn. The strengths and the weaknesses are described. The potential areas for improvement are also presented. As discussed in the previous chapters, the determinants are structured in accordance to the parties on the market: the demand – the general public, and the supply – the dealers or the banks.

### **Paragraph 1. Demand Aspect**

We begin our analysis with the demand side study. The hypothesis is that the biased consumer FX conversion operations provoke the dealers impose higher tariffs in the more demanded types of transactions. For example, if the public prefers buying Dollars to selling dollars, the banks are expected to set higher ask premium than the bid discount for operation with US Dollars.

The statistical data about the demand, provided by the Central Bank of Russia, as well as the asymmetries in pricing USD and EUR are presented in the chart below.

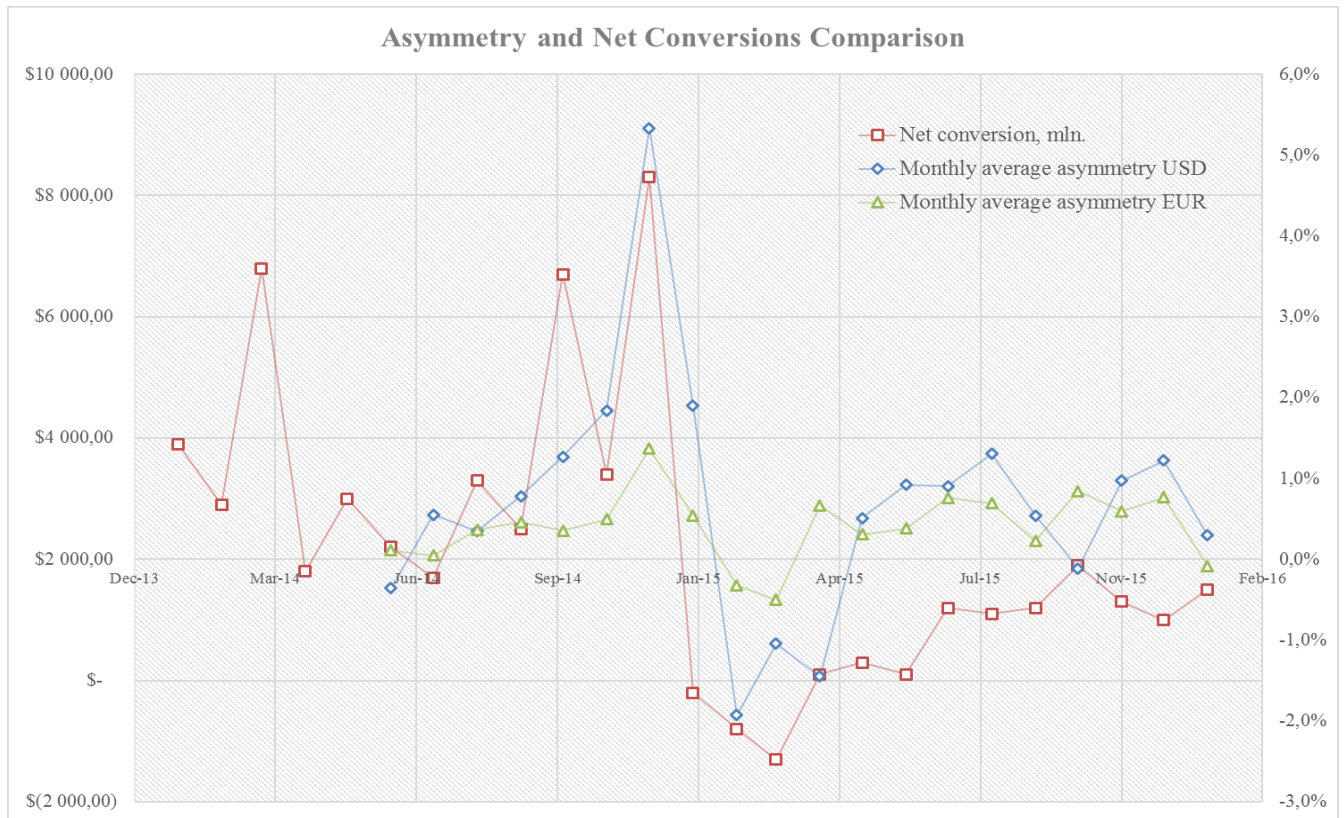


Figure 16. The chart represents monthly net FX conversion operations with cash RUB in USD millions and average monthly asymmetries for USD and EUR cash exchange rates in percentage points.

The chart represents the relation between the average asymmetry in the cash currency exchange rates and the net account of currency conversion operations. These two pairs of elements: USDRUB asymmetry with net conversion and EURRUB asymmetry with net conversion demonstrate the strong connection.

The degree of their relation was measured by the correlation metrics. The correlation matrix for the three variables is presented on the next figure.

	<b>Asymmetry in USD</b>	<b>Asymmetry in EUR</b>	<b>Net Conversion Balance</b>
<b>Asymmetry in USD</b>	100,0%	-	-
<b>Asymmetry in EUR</b>	69,7%	100,0%	-
<b>Net Conversion Balance</b>	<b>70,5%</b>	<b>51,8%</b>	100,0%

Figure 17. Correlation matrix for monthly average asymmetries in USD and EUR retail prices and for the net retail FX conversion. It turns out, that the correlation with net conversions balance coefficient

*for USD is higher than for the EUR. This can be explained by the fact, that USD transactions volume is much greater than EUR. Therefore, the retail USD market is more liquid and better reflects the shifts in demand.*

The statistical analysis demonstrates a strong connection between the asymmetry magnitudes and the net conversion balance for both currency pairs. The conversion balance has higher correlation coefficient with asymmetries in US Dollar prices than with the Euro rate asymmetries. The reason behind that effect is the difference in volumes of the respective transactions. The transaction type volumes mean different liquidity levels of the markets. USD retail market is more liquid and better reflects the changes in demand.

The analysis of demand side shifts and changes in asymmetry patterns has demonstrated a strong positive connection. The higher the demand for foreign currency from the population, the larger is the ask premium than the bid discount for a unit of foreign currency. And vice versa: the higher the supply of foreign currency from the population, the greater the bid discounts as compared to the ask premiums. This proves the hypothesis, that the higher demand for certain financial products leads to higher transaction costs for that operation.

## **Paragraph 2. Supply Aspect**

The other side of our analysis focuses on the supply side of the retail foreign exchange market: on the market-makers and the issues relevant to them. As mentioned above, there are two types of factors, which influence the market makers. These are the interbank FX market price, which is equally important for all the dealers, and the competitive factors, which are specific for every single dealer and are therefore out of the scope of this research. So the focus in this research is made on the influence the FX market has on the retail bid and ask quotes.

As mentioned above, there are 7 consecutive periods on the FX market with different trends and characteristics. These periods were analyzed in terms of the bid-ask spread asymmetry. Our sets of data for USDRUB and EURRUB were split into 7 parts each. The rates for each of the periods were analyzed for each bank. The averages, medians and standard deviations over periods were calculated for each of the banks. After that, the frequency histograms for average asymmetries in different banks for each period were created.

The hypothesis here is that the dealers, who see movements in the FX rates set higher commissions in the direction of the trend.



The histograms (See Appendix 2) demonstrated narrow peaks of average asymmetry. Positive median asymmetry was present when the uptrend was on the market. The asymmetry was close to zero when there was a side trend or stagnation on the market. The asymmetry was negative, when Dollar and Euro sank against Ruble.

In other words, when the US Dollar and Euro appreciated against Ruble, most of the banks required higher margin for selling the currency to the public. When the Ruble strengthened, the banks required higher margins for selling Rubles to the public. When there was stagnation on the FX market, the banks published equal margins: bid discounts equal to ask premiums, for selling and for buying the cash foreign currency.

<b>USDRUB Asymmetry Analysis</b>					
	Beginning of Period	End of Period	Volatility average: (High-Low)/ open	Monthly Change over the period	Average asymmetry published by the greatest number of banks
<b>1</b>	1-Jun-14	1-Nov-14	1,07%	4,64 %	0,51 %
<b>2</b>	1-Nov-14	31-Jan-15	4,95%	20,47%	4,51 %
<b>3</b>	1-Feb-15	20-May-15	3,12%	-7,88%	-1,67%
<b>4</b>	20-May-15	31-Aug-15	2,39%	9,46 %	2,25 %
<b>5</b>	1-Sep-15	15-Oct-15	2,37%	-1,27%	-0,03%
<b>6</b>	16-Oct-15	20-Jan-16	2,07%	7,64 %	1,63 %
<b>7</b>	21-Jan-16	22-Mar-16	2,74%	-5,54%	-1,06%

Figure 18. The chart of the USDRUB retail quotes asymmetry. The periods of stronger trends on the market correspond to more significant average asymmetry.

<b>EURRUB Asymmetry Analysis</b>					
	Beginning of Period	End of Period	Volatility average: (High-Low)/ Open	Monthly Price Change over the period	Average asymmetry published by the greatest number of banks
<b>1</b>	1-Jun-14	1-Nov-14	1,13%	2,03 %	0,54 %
<b>2</b>	1-Nov-14	31-Jan-15	5,26%	14,95%	2,54 %
<b>3</b>	1-Feb-15	20-May-15	3,10%	-8,12%	-0,61%
<b>4</b>	20-May-15	31-Aug-15	2,71%	9,74 %	0,95 %
<b>5</b>	1-Sep-15	15-Oct-15	2,71%	-1,58%	-0,15%
<b>6</b>	16-Oct-15	20-Jan-16	2,38%	7,66 %	0,77 %
<b>7</b>	21-Jan-16	22-Mar-16	3,25%	-5,20%	-0,38%

Figure 19. The chart of the EURRUB retail quotes asymmetry. The periods of stronger trends on the market correspond to the more significant average asymmetry.

The two tables above describe the general patterns of retail banks pricing policy for currency conversion services. It is evident from the table, that during stable trends of dollar strengthening, the

asymmetry is positive. During the reversal trend directions, the asymmetry is negative on average. The general result is clear and corresponds to the expectations of the demand and supply analysis. This supports the hypothesis, that the banks set up asymmetries in the direction of the FX trends. However, it is desirable to have a more precise model for the retail FX transactions pricing.

### **Paragraph 3. Asymmetry Regression Model**

Due to the dataset limitations, we assume here that the FX market price movements have the most significant influence on the market makers. The model is based solely on the data about the FX market prices. We have seen so far that the dealers apparently take the FX market trends into account for publishing the retail exchange quotes.

It is also assumed that the banks which offer retail foreign exchange services exploit only the historical data from the market. In other words, on the date publishing the bid-ask spread asymmetry depends only on the previous to that date FX price movements. The FX market is very liquid and the price changes are very frequent. It is practically impossible to base the model on all of the price changes. Furthermore, the scope of the research is different. Most of the banks publish their rates once a day or even more rarely. That is why it is probable that the banks focus on the price changes over the full trading sessions.

The results we have so far are: the descriptive statistics for USDRUB and EURRUB asymmetry in retail exchange rates, the market trends over the observation period, the correlation of the average monthly asymmetry and the net conversion balance. In all of the studies, the results for USD and for EUR were similar. That is why, we build the model symmetrically for both of the currency pairs.

The hypothesis on this stage is that on average the banks determine the asymmetry in their bid-ask spreads according to the most recent history of the interbank FX market price movements.

We use the asymmetry as a dependent variable and the historical price changes as the independent ones. We start with the FX price change during the date of publishing the retail rate, say day [0], then we include the overnight change from the end of trading session a day ago [-1] and the current day [0]. We look at the price change during the regular trading session the previous trading day [-1]. The fourth point is the night change between the day [-1] and the day [-2]. The price change during the trading session two days ago [-2] is the deepest point into the history.

The list of the independent variables for the asymmetries in cash foreign exchange rates are:

(1) Trend of Today (retail rate publishing date)

$$\text{Trend.TDY} = \text{Close.FX.DAY0} - \text{Open.FX.DAY0}$$

(2) Trend of Today Night

$$\text{Trend.TDYNGHT} = \text{Open.FX.DAY0} - \text{Close.FX.DAY-1}$$

(3) Trend of Yesterday

$$\text{Trend.YSTD} = \text{Close.FX.DAY-1} - \text{Open.FX.DAY-1}$$

(4) Trend of Yesterday Night

$$\text{Trend.YSTDNGHT} = \text{Open.FX.DAY-1} - \text{Close.FX.DAY-2}$$

(5) Trend of the Day Before Yesterday

$$\text{Trend.DbYSTD} = \text{Close.FX.DAY-2} - \text{Open.FX.DAY-2}$$

We take USD FX rates for asymmetry in US Dollar cash exchange quotes, and EUR FX rates for Euro respectively.

The econometric model is formulated the following way for the USDRUB cash currency exchange rates asymmetry:

$$\begin{aligned} \text{Asymmetry.USD} = & a + p_1 \cdot \text{Trend.TDY} + \\ & + p_2 \cdot \text{Trend.TRYNGHT} + p_3 \cdot \text{Trend.YSTD} + \\ & + p_4 \cdot \text{Trend.YSTDNGHT} + p_5 \cdot \text{Trend.DbYSTD} + \xi \end{aligned}$$

Where,

a – is the intercept term,

$p_i$  – the regression coefficients,

$\xi$  – the error term.

The model for the EURRUB retail conversion rates asymmetry takes the following form:

$$\begin{aligned} \text{Asymmetry.EUR} = & b + q_1 \cdot \text{Trend.TDY} + \\ & + q_2 \cdot \text{Trend.TRYNGHT} + q_3 \cdot \text{Trend.YSTD} + \\ & + q_4 \cdot \text{Trend.YSTDNGHT} + q_5 \cdot \text{Trend.DbYSTD} + \zeta \end{aligned}$$

Where,

b – is the intercept term,

$q_i$  – the regression coefficients,

$\zeta$  – the error term

The data we are dealing with is panel data. There are quotes for each date since June 2014 till March 2016 issued by each of the 74 banks during the observation period. A set of one bank rates over time is time series dataset, a set of rates of different banks for each particular date is cross-sectional date. The data is both cross-sectional and time-series, so the panel data analysis methods was applied. The both datasets were analyzed on be subject to fixed or random effects analysis methods with Hausman’s tests. The results stated clearly, that the fixed effects approximation must be used for both samples.

Fixed-effects (within) regression		Number of obs	=	43351		
Group variable: BankNumber		Number of groups	=	74		
R-sq: within	= 0.1510	Obs per group: min	=	150		
between	= 0.0668	avg	=	471.2		
overall	= 0.1449	max	=	660		
corr(u_i, Xb) = 0.0041		F(5, 43254)	=	1538.61		
		Prob > F	=	0.0000		
-----						
DependentAsymmetry		Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
-----						
trendtoday		.0063349	.0001161	54.54	0.000	.0061072 .0065625
trendtodaynight		-.018564	.0003962	-46.85	0.000	-.0193406 -.0177874
yesterdaytrend		-.0026916	.0001408	-19.11	0.000	-.0029676 -.0024156
trendYesterdaynight		.0002942	.0003042	9.67	0.000	.0023458 .0035383
TrendDaybefore		.0008638	.0001294	6.68	0.000	.0006102 .0011174
_cons		.0014959	.0001169	12.79	0.000	.0012667 .0017251
-----						
sigma_u		.00603323				
sigma_e		.02392302				
rho		.05979824	(fraction of variance due to u_i)			
-----						
F test that all u_i=0:		F(91, 43254) =	26.55		Prob > F =	0.0000

Figure 20. Panel fixed effects regression analysis results for USDRUB retail rates asymmetry as a function of FX price trends during the tree previous days and two previous nights.

Fixed-effects (within) regression		Number of obs	=	40525		
Group variable: Bank		Number of groups	=	89		
R-sq: within	= 0.2534	Obs per group: min	=	146		
between	= 0.1074	avg	=	455.3		
overall	= 0.2428	max	=	660		
corr(u_i, Xb) = 0.0048		F(5,40431)	=	2745.01		
		Prob > F	=	0.0000		
-----						
AsymmetryEUR		Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
-----						
TrendTDY		.0064936	.0000759	85.55	0.000	.0063449 .0066424
TrendTDYnight		-.0113774	.0002656	-42.83	0.000	-.011898 -.0108568
TrendYSTD		-.0036187	.0000817	-44.28	0.000	-.0037789 -.0034585
TrendYSTDnight		-.0009618	.0002072	-4.64	0.000	-.001368 -.0005557
TrendBfYSTD		-.0001344	.0000797	-1.69	0.092	-.0002906 .0000218
_cons		.0028065	.0001043	26.91	0.000	.0026021 .003011
-----						
sigma_u		.00553349				
sigma_e		.02073307				
rho		.06649474	(fraction of variance due to u_i)			
-----						
F test that all u_i=0:		F(88, 40431)	=	29.21	Prob > F = 0.0000	

Figure 21. Panel fixed effects regression analysis results for EURRUB retail rates asymmetry as a function of FX price trends during the tree previous days and two previous nights.

The regression analysis for both of the variables shows high degree of significance of both of the models. The probabilities that the coefficients are statistically insignificant are close to zero. This means that the hypotheses of statistically insignificant regression coefficients for both models are rejected. It should be mentioned that the asymmetry is measured in percentage points, so the results should be multiplied by 100, to arrive at percentage form.

The coefficients become closer to zero, as the number of period they are responsible for goes deeper in the history. This means that the linear process is dependent less of the information about the older periods. To make things simple, our process has memory and that memory is poor: newer information is stored better than the older.

If we translate it into the real terms, it means that the managers of the retail banks, who are responsible for assigning the bid and ask rates for cash currency exchange, pay more attention to the most recent information and care less about the older data. In general, the asymmetry in cash foreign exchange rates is measured as a weighted sum of changes in trends of previous periods.

	USDRUB asymmetry (%)	EURRUB asymmetry (%)
Trend TODAY	0.63	0.65
Trend TODAY night	-1.86	-1.14
Trend YESTERDAY	-0.27	-0.36
Trend YESTERDAY night	0.03	-0.09
Trend the DAY before YESTERDAY	0.09	-0.01

*Figure 22. The summary table of the regression models for asymmetry in USDRUB and EURRUB currency pairs. The similar features are that the latest trend is used with a positive sign, what was expected. The two previous periods coefficients are used with the negative sign. The greatest impact on the calculated asymmetry, in terms of the coefficient magnitude, have the overnight changes in the FX price, off the regular trading sessions.*

The results of the econometrical modelling are summarized in a table below. Generally, the banks follow the logic of imposing positive asymmetry, if the price is going up in the current moment currently. The also use the contrarian strategy against the price changes during the previous night and previous trading session. So they react in an opposite way to the information from the previous night and the previous trading day.

The low magnitudes of  $P > |t|$  values and decreasing weight of trends in historical depth supports the hypothesis, that the most recent changes on the FX market influence the bid-ask spread asymmetry most.

The main strength of the finding is that it gives a clear picture of the factors, influencing the asymmetry in bid-ask spreads. It covers both aspects of the market: the supply and demand and focuses on 99% of all transactions: USD and EUR transactions. The empirical results meet the theoretical expectations.

The key area for improvement is the deeper analysis of the consumer behavior patterns on the market and finding the ways to predict them. This would create a fundamental forecasting basis for the asymmetry model. Another path for deeper analysis of the topic would be to find the fundamental reasons behind the different signs in accounting for historical trends on the market to calculate the asymmetry.

#### **Paragraph 4. Conclusion**

The research provides the analysis of the asymmetrical bid-ask spreads published by the Moscow retail banks, which make the market of cash currency exchange. The bid and ask quotes turn out not to be equidistant from the major reference rate. In the periods of FX uptrend the dealers ask for

higher margin of selling foreign cash to the public and in the periods of downtrend, the margins on buying foreign currency is higher.

The asymmetry was defined as a function of bid and ask prices and of the open price on the FX market for each currency pair:

$$\text{Asymmetry} = \frac{(\text{Ask} - \text{Open. FX}) - (\text{Open. FX} - \text{Bid})}{\text{Open. FX}} * 100\%$$

The relative formulation is preferred to the absolute, because the base rate changed significantly over the course of observations.

The main goal of the research was to find the factors that determine the asymmetry in pricing the cash exchange services. The objectives were:

- (1) Study the existing academic papers about FX dealer market microstructure
- (2) Outline a complete set of factors, that may influence the asymmetry in bid-ask spreads
- (3) Collect the necessary data: the retail bank quotes, FX historical rates and the statistics about the consumer trends
- (4) Analyze the data and offer a model for calculating the market-average asymmetry

The academic research about market microstructure in the retail FX conversion market is far from plentiful. There have been papers about the bid-ask spread in general and about the spreads on different local markets. However, the topic of bid-ask asymmetry was unexplored yet.

The research gap is worsened by the latest events on the Russian retail FX market. During the last two years, the FX quotes were highly volatile and the retail bid-ask spread sometimes even enabled arbitrage transactions. This proves the academic relevance of the research.

The factors influencing the difference in bid and ask price formulation were split into demand (the public) and supply (the banks) sides. The first group was determined to be influenced by Ruble devaluation expectations. The latter were identified to be subject to the FX market trend changes.

The data required for the research was (a) the retail quotes from the banks, (b) the FX market data and (c) the statistics about the consumer spending on the retail FX market.

The results of the analysis revealed that all the factors, that were predicted by theory to be strongly connected to the asymmetry and which were analyzed, are actually important for the general asymmetry on the retail FX market.

Managerial application of the research is aimed at the retail bank officers, who are responsible for calculating the bid and ask quotes. The research sheds light on how the asymmetry can be used to

make the spread narrow to attract the customers and to still make profit on the transactions. The regression model presented enables the management to calculate the average asymmetry present on the market with the given FX market history.

As the research demonstrated, there is a strong association of the net consumer foreign exchange transactions and the asymmetry in the cash currency bid-ask spreads. However, the correlation for asymmetries in USD is higher than for EUR. Perhaps, the greater transactions volume helps make the market more informationally efficient.

Manager of a retail bank can use the research to compare the bank's rates he publishes with the fair market rates policy. The banks are advised to impose positive asymmetry, or higher ask premium than bid discount during the bullish trends on the market, symmetrical quotes during the stagnation and negative asymmetry, greater bid discounts than ask premiums, in the periods of bearish market trends.<sup>1</sup>

The bank managers may also take advantage of the fact, that the retail FX market takes into account only the current trend direction: for the day of retail FX rates publishing, of the previous overnight change in price and of the change in price on the previous trading day.

The research has also shown that the asymmetry is determined by the power of the trend on the interbank FX market. The strengthening currency basket provokes higher commissions for purchasing foreign currency than for selling it. On the contrary, the negative trend on FX market, leads to higher commissions for selling foreign cash.

The econometrical model revealed the bid and ask asymmetry depends on the FX market history. The asymmetry calculation is a model with memory. This memory is poor. The average bank manager cares more of the recent market changes than of the older history.

The future research in this field could further study two groups of factors: the demand and the supply. The demand analysis would require better understanding the consumer behavior patterns and ways to predict them. The supply study could reveal the reasons behind the contrarian strategy of the average asymmetry: why the signs in previous periods coefficients are negative.

All in all, the paper presents the first academic research analyzing the asymmetries on the retail FX market. The goal was to analyze the data and find the influencing factors. The factors were inferred theoretically and then were supported empirically. The main factors are the following: (1) the consumer temporary preferences drive the demand up and shift the asymmetry, making the most

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<sup>1</sup> The trends are referred to as bullish or bearish in the direct FX quotation for Ruble.



popular transaction the most expensive, (2) the FX market changes make the bank managers set up higher margins in the direction of price changes for both purposes: risk hedging and consumer surplus extracting.

## List of References

- (1) Copeland, T. E., & Galai, D. (1983). Information Effects on the Bid-Ask Spread. *The Journal of Finance*, 38(5), 1457-1469.
- (2) Enn Listra, Niina Vaiser and Katrin Rahu (2011). Systematic Differences of Retail Exchange Spreads in Some EU Counties: The Banks Against Financial Integration. *Discussions on Estonian Economic Policy No. 2/2011*.
- (3) EUR/RUB Historical Data (retrieved on 2016, March 22), retrieved from <http://www.investing.com/currencies/eur-rub-historical-data>
- (4) Foreign Exchange Rates Archive, (retrieved on 2016, March 10), retrieved from [http://data.sberbank.ru/moscow/ru/quotes/archivecurrencies/index.php?all\\_data115=1](http://data.sberbank.ru/moscow/ru/quotes/archivecurrencies/index.php?all_data115=1)
- (5) Galati G. (2001). Trading Volumes, Volatility and Spreads in FX Markets: Evidence from Emerging Market Countries. Bank for International Settlements, 2001. *BIS Papers*, №2, pp.197–225. Available at: <http://www.bis.org/publ/work93.htm>
- (6) Garman M. and Klass M. (1980), Estimation of Security Price Volatility from Historical Data. *Journal of Business*, 1980, vol. 53, 1, pp. 67-78.
- (7) Historical currency exchange rates in Moscow banks (retrieved on 2016, March 22), retrieved from <http://koyalut.ru/history.php?kod=7701>
- (8) Historical Oil prices Brent and WTI (retrieved on 2016, March 15), retrieved from <http://www.investing.com/commodities/brent-oil-streaming-chart>
- (9) Hussain S. (2011). The Intraday Behaviour of Bid-Ask Spreads, Trading Volume and Return Volatility: Evidence from DAX30. *International Journal of Economics and Finance*, Vol.3, No.1.
- (10) Internal foreign exchange market review by Central Bank of Russia on January 2015 (retrieved on 2016, April 10), retrieved from [http://www.cbr.ru/analytics/bank\\_system/Exp15\\_01.pdf](http://www.cbr.ru/analytics/bank_system/Exp15_01.pdf)
- (11) Internal foreign exchange market review by Central Bank of Russia on January 2016 (retrieved on 2016, April 10), retrieved from [http://www.cbr.ru/analytics/bank\\_system/Exp16\\_01.pdf](http://www.cbr.ru/analytics/bank_system/Exp16_01.pdf)

- (12) Kyle, A. S., & Obizhaeva, A. A. (2004). Market Microstructure Invariance: Empirical Hypotheses. SSRN Electronic Journal SSRN Journal. Available at SSRN:  
<http://ssrn.com/abstract=1687965>
- (13) Mankiw, N. G. (1998). Principles of economics (4th ed.). Fort Worth, TX: Dryden Press.
- (14) Retail FX market review by Vedomosti (retrieved on 2016, April 7), retrieved from <https://www.vedomosti.ru/finance/articles/2016/02/26/631516-pokupat-valyutu-birzhe-vsegda-vigodno>
- (15) Russian commercial banks comparison table. (retrieved on 2016, April 18), retrieved from [http://www.banki.ru/banks/?order=fin\\_rating](http://www.banki.ru/banks/?order=fin_rating)
- (16) Russian holiday making statistics by Rossiyskaya Gazeta (retrieved on 2016, April 12), retrieved from <http://rg.ru/2010/07/20/otpusk.html>
- (17) Russian Standard Bank Historical Foreign Exchange Rates (retrieved on 2016, March 28), retrieved from [www.rsb.ru/courses/](http://www.rsb.ru/courses/)
- (18) Saida Gtifa, Samir Maktouf and Nadia Labidi (2015). Dealer Behavior and Price Strategy in the Foreign Exchange Market: Evidence from FX Tunisian Market Dealer. *Journal of Business Studies Quarterly* 2015, Volume 7, Number 2.
- (19) Sarno L. And Taylor M. (2003). *Economics of Exchange Rates*. Cambridge University Press. Cambridge, 2003. doi:10.2277/0521485843.
- (20) Savenkov P.G. (2015). The research on bid-ask quotes on Russian cash-currency market (Master dissertation, Saint Petersburg University, Graduate School of Management, Master in Corporate Finance Program).
- (21) USD/RUB Historical Data (retrieved on 2016, March 22), retrieved from <http://www.investing.com/currencies/usd-rub-historical-data>

## Appendices

### Appendix 1.

The list of the banks in the full sample and the list of banks, subject to further analysis.

All the banks names collected
«АК БАРС» БАНК
Абсолют Банк
Азиатско-Тихоокеанский Банк
Азия-Инвест Банк
АИКБ «Татфондбанк»
АйМаниБанк
АКБ "СТРАТЕГИЯ" (ПАО)
АктивКапитал Банк
Алеф-Банк
АЛЬФА-БАНК
АО «РОСТ БАНК»
АО КБ «АГРОПРОМКРЕДИТ»
Арсбанк
БайкалИнвестБанк
БАЛТИНВЕСТБАНК
Банк "Агророс"
Банк "АЗИМУТ"
Банк "АКРОПОЛЬ"
Банк "Балтика"
Банк "Легион"
Банк "Мегаполис"
Банк "ПЛАТИНА"
Банк "Пойдём!"
Банк "Пурпе"
Банк "РБР"
Банк "Таврический"
БАНК "ЮГРА"
БАНК "МОСКВА-СИТИ"
Банк «Богородский»
Банк «ВБРР»
БАНК «ВЕК»
Банк «Возрождение»
Банк «Восточный»* *(комиссия от 0 до 45 руб)
Банк «ВПБ»

Банк «ГЛОБУС»
Банк «ГЛОБЭКС»
Банк «ДАЛЕНА»
Банк «Камский горизонт»
Банк «Кредит-Москва»
Банк «ЛОГОС»
БАНК «МБФИ»
Банк «Новопокровский»
Банк «Новый век»
Банк «Развитие-Столица»
Банк «РЕСО Кредит»
Банк «РТБК»
Банк «РУБЛЕВ»
Банк «Северный Кредит»
Банк «Советский»* *(взимается комиссия 75 руб.)
Банк «Таатта»
Банк «ТРАСТ»
Банк «ФК Открытие»
Банк «Экспресс-кредит»
Банк АВБ
Банк Город
Банк ЗЕНИТ
Банк Инноваций и Развития
БАНК ИТБ
Банк МКБ
Банк Москвы
Банк Оранжевый
Банк Развития Технологий
Банк Российский Кредит
Банк РСИ
БАНК СГБ
Банк СОЮЗ
БАНК УРАЛСИБ* *(взимается комиссия 30 рублей)
Банк ФИНАМ
Банк Финсервис
Банк Экономический Союз
Банк24.ру
Банкхаус Эрбе
Бенифит-банк
БИНБАНК

БКС Банк* *(взимается комиссия от 0% до 2%)
Владпромбанк
ВЛБАНК
Внешпромбанк
ВНЕШФИНБАНК
ВТБ 24* *(взимается комиссия от 0 до 150 руб)
Выборг-банк
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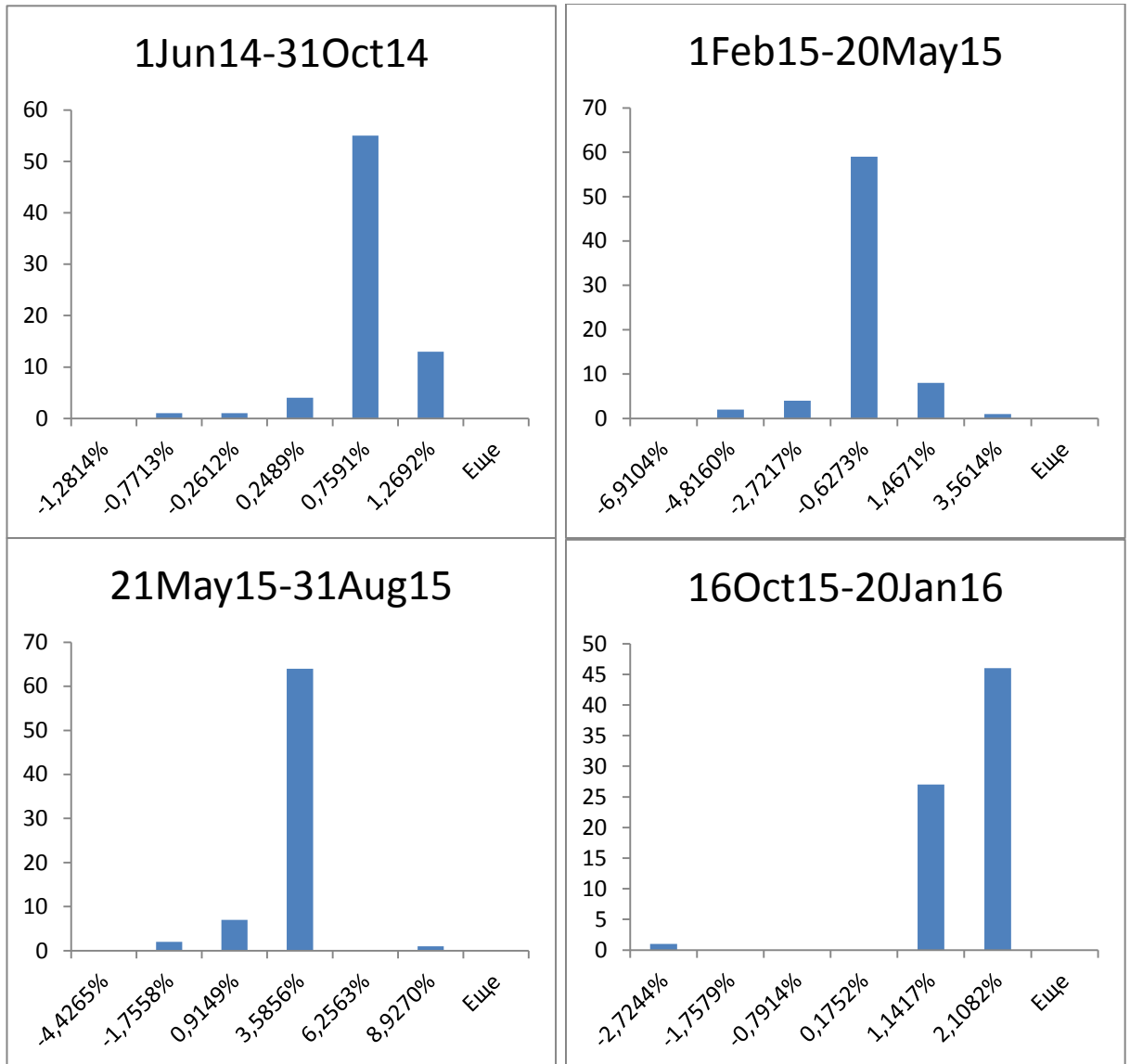
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## Appendix 2

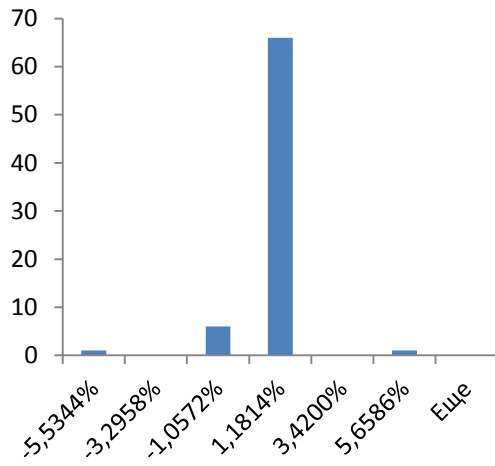
The histograms of frequency distribution of average over time asymmetries across banks.

USDRUB

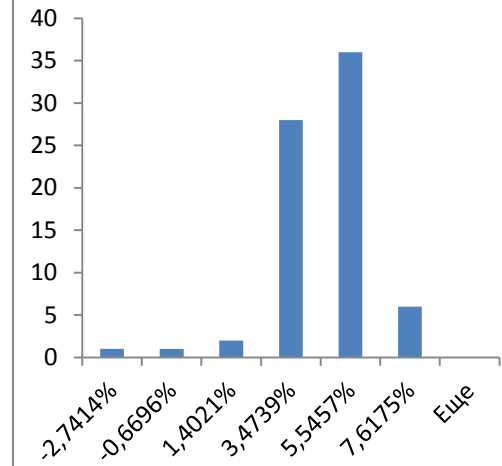




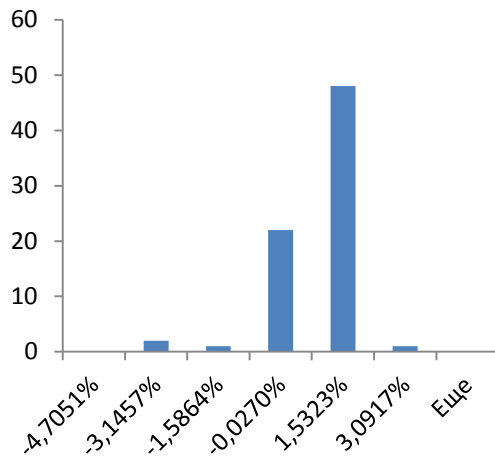
21Jan16-22Mar16



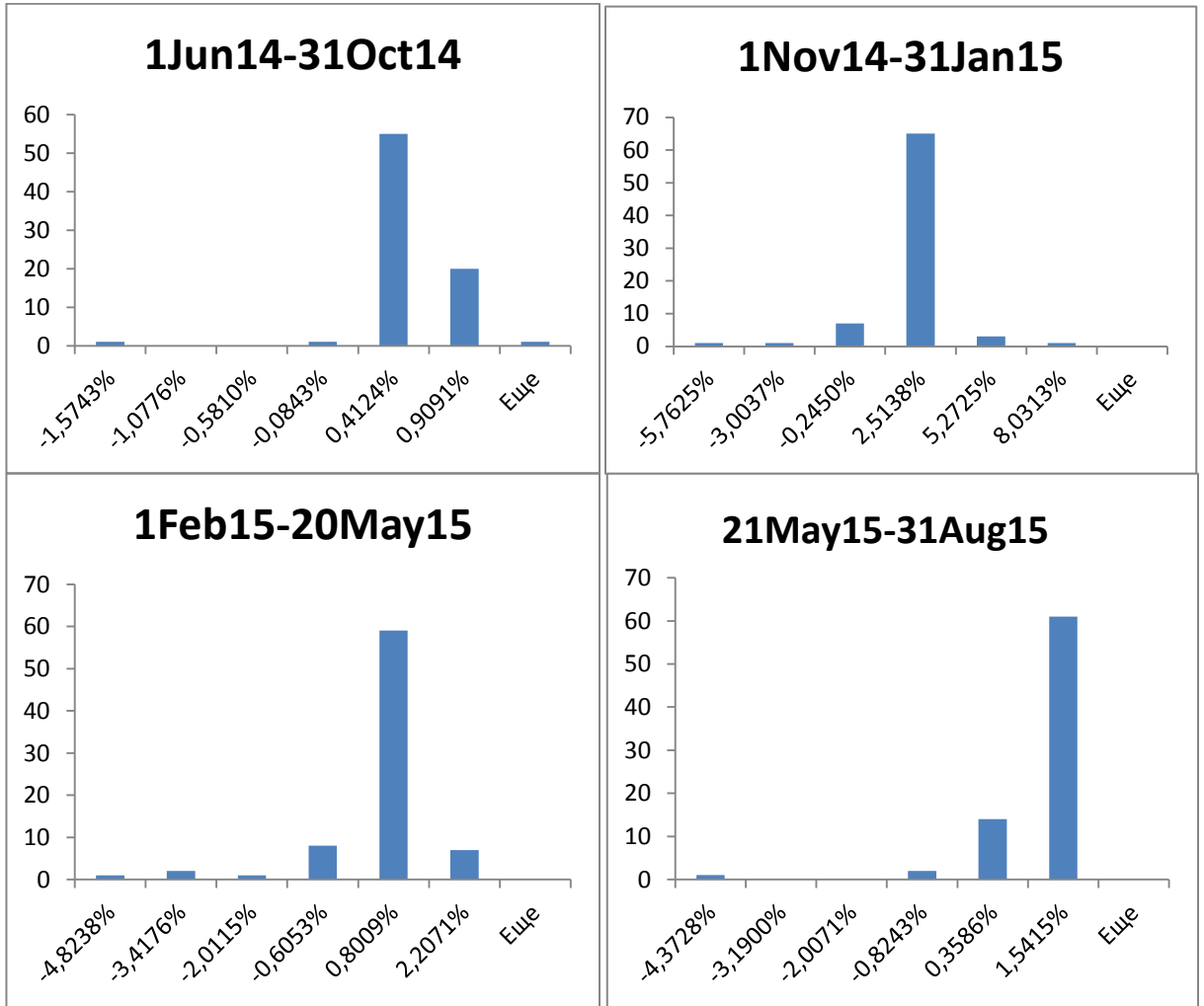
1Nov14-31Jan15



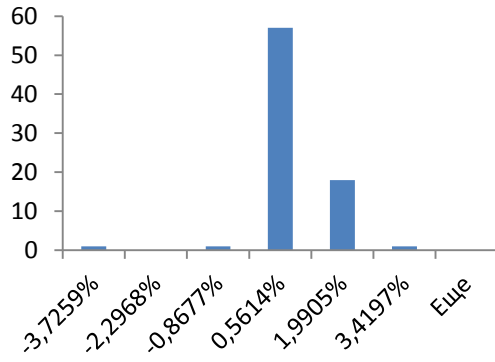
1Sep15-15Oct15



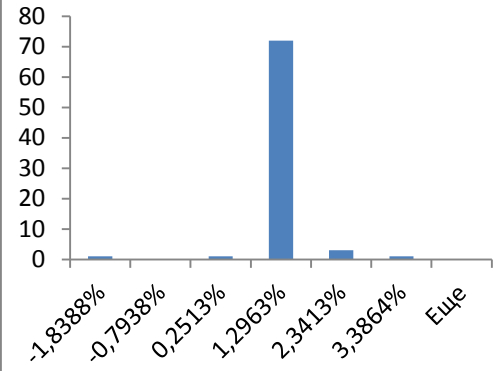
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### 1Sep15-15Oct15



### 16Oct15-20Jan16



### 21Jan16-22Mar16

