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Bachelor Thesis

Analysis of Real Estate Market in Russia

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Objectives of thesis

The goal of the bachelor thesis is to assess the Russian estate market with the basis of Saint Petersburg. The analysis will be done by implementing the regression model to determine how some factors influence the price for the square meter in the real estate market and analyzing the availability of the estate in primary and secondary markets in Saint Petersburg in the last six years.

Methodology

This bachelor thesis consists of two parts: the theoretical and practical parts. The theoretical part describes the basic concepts related to the Russian real estate market. The writing of the theoretical part is based on data collected from specialized publications, legal acts, and other written or online sources, and it was selected using the inductive method of research and index analysis related to the topic. The practical part consists of the regression analysis method and the standard UN-HABITAT method of calculations of affordability indexes of real estate. The data used in the practical part was collected from various online specialized statistic resources.

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Real Estate, Mortgage, Flat, Price, Interest Rate, Saint Petersburg

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Asaul, A. (2013). Ekonomika nedvizhimosti (Real estate economics). St. Petersburg. 416 p. ISBN: 978-5-496-00057-4.

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Vasilyeva, N. (2008). Ekonomika nedvizhimosti (Real estate economics). Moscow. 480 p. ISBN: 978-5-699-26391-2.

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Declaration

I declare that I have worked on my bachelor thesis titled "Analysis of Real Estate Market in Russia" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 14.03.2021

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Analysis of Real Estate Market in Russia

Abstract

The bachelor's thesis Analysis of Real Estate Market in Russian focused on analysing Saint Petersburg real estate market, divided into two main parts: theoretical and practical.

The theoretical part provides basic concepts related to the real estate market. The author explains aspects of the Russian estate market, market participants, government support, and regulations measures.

The practical part analyses the real estate market of Saint Petersburg. The idea of the practical part is to check the sensitivity of prices in the primary estate market to economic measures and the total affordability of the purchasing estate in the city according to the average salary in the chosen city. For the calculation, regression analysis and the UN-HABITAT method of calculations of affordability indexes were used.

Keywords: Real estate market, mortgage rate, inflation rate, price, primary market, Saint Petersburg, regression analysis

Analýza Trhu s Nemovitostmi v Rusku

Abstrakt

Tato bakalářská práce se zabývá analýzou realitního trhu v Rusku se záměrem na trh s nemovitostmi v Petrohradu a je rozdělena do dvou částí: teoretické a praktické.

Teoretická část obsahuje základní pojmy, které se vztahují k trhu nemovitosti. Autor vysvětluje aspekty trhu nemovitosti v Rusku, účastníky trhu, podporu vlády a regulační opatření.

Praktická část analyzuje trh nemovitosti v Petrohradu. Cílem je ověření cenové citlivosti na primárním realitním trhu na změnu ekonomických indikátorů a celkovou cenovou dostupnost nákupu nemovitosti ve městě podle průměrně mzdy ve zvoleném městě.

Pro výpočet byly použity metoda regresní analýzy a metoda výpočtu indexu cenové dostupnosti UN-HABITAT.

Klíčová slova: realitní trh, úrokové sazby hypoték, míra inflace, cena, primární trh, Petrohrad, regresní analýza

Table of content

<i>1 Introduction</i>	11
<i>2 Objectives and Methodology</i>	13
2.1 Objectives	13
2.2 Methodology	13
<i>3 Literature Review</i>	16
3.1 The Movables and Immovables	16
3.2 Land Composition in the Russian Federation	16
3.3 Classifications of real estate objects	18
3.3.1 Land and Land plot	19
3.3.2 Residential premises	19
3.3.2.1 Primary and secondary estates.....	20
3.3.3 Non-residential properties	21
3.3.4 Capital construction objects	21
3.3.5 Apartment Building.....	21
3.4 Ownership for real estate	21
3.4.1 State Registration of the real estate	22
3.4.2 The Unified State Register of Real Estate of the Russian Federation	22
3.4.3 National system of spatial data	22
3.5 Real estate Market	23
3.5.1 Seller	23
3.5.2 Buyer.....	24
3.5.2.1 Foreign buyers	25
3.5.3 Professional participants	25
3.5.4 Real estate activity	26
3.5.5 Avito	27
3.5.6 Investor	27
3.6 Taxation of real estate	27
3.7 The Central Bank	29
3.7.1 Commercial Banks	30
3.7.2 Mortgage loans	30
3.7.2.1 Mortgage interest rate.....	32
3.8 State support programs	33
<i>4 Practical part</i>	36
4.1 Introduction to Saint Petersburg	36
4.2 Regression analysis	36
4.2.1 The dependent variable	37
4.2.2 Independent Variables	37
4.2.3 Used data.....	38
4.2.4 Matrix of Correlation	39
4.2.5 Regression modeling 1.....	42
4.2.5.1 First regression equation	42
4.2.5.2 Evaluation of the first model	43
4.2.6 Regression modelling 2.....	45

4.2.6.1 Second regression equation	46
4.2.6.2 Evaluation of the second model	46
4.2.7 Results of the regression analysis	47
4.3 Analysis of affordability of the residential estate	48
4.3.1 Introduction to UN-HABITAT	49
4.3.2 Affordability index in Saint Petersburg	49
4.3.3 Calculation of the affordability index	50
4.3.4 Evaluation of the affordability index	51
5 Conclusion	53
6 References	54
6.1 Literature.....	54
6.2 Laws and Resolutions:	55
6.3 Online resources	56

Table of Figures

FIGURE 1. LAND FUND DISTRIBUTION (OWN SOURCE).....	18
FIGURE 2. AVERAGE PRICE FOR 1M ² IN RUSSIA (RUSSIAN STATISTIC OFFICE).....	20
FIGURE 3. MORTGAGE INTEREST RATE IN RUSSIA (RUSSIAN STATISTIC OFFICE)	32
FIGURE 4. KEY RATE STATISTICS (BANK OF RUSSIA)	33
FIGURE 5. RUSSIAN DISTRICTS MAP-FAR EASTERN DISTRICT (SOURCE WIKIPEDIA)	35
FIGURE 6. DATA USED FOR THE REGRESSION ANALYSIS (OWN SOURCE)	39
FIGURE 7. CORRELATION MATRIX (OWN SOURCE)	40
FIGURE 8. REGRESSION STATISTICS FOR x_1, x_2, x_4, x_5 (OWN SOURCE).....	40
FIGURE 9. REGRESSION STATISTICS FOR x_2, x_3, x_4, x_5 (OWN SOURCE)	41
FIGURE 10. ADJUSTED CORRELATION MATRIX (OWN SOURCE)	41
FIGURE 11. REGRESSION MODEL 1(OWN SOURCE).....	42
FIGURE 12. ILLUSTRATION OF Y AND Y' (OWN SOURCE) -1	43
FIGURE 13. REGRESSION MODEL 2 (OWN SOURCE)	45
FIGURE 14. ILLUSTRATION OF Y AND Y' (OWN SOURCE) -2	46
FIGURE 15. AFFORDABILITY INDEX CALCULATIONS	51
FIGURE 16. AFFORDABILITY INDEXES DYNAMICS (OWN SOURCE).....	52

Table of tables

TABLE 1. TAX RATES (§406 THE TAX CODE OF THE RUSSIAN FEDERATION)	29
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I Introduction

The real estate market is the basis of a market economy since it is a sphere of capital investment in real estate and a system of economic relations arising from real estate transactions. The list of transactions is enormous, for example, mortgage, buying and selling real estate, renting out the estate, and so on.

However, in modern Russia, the concept of "real estate" was again introduced into economic and legal circulation by the law of Russian SFSR only in 1991 on establishing the status of private ownership of land. Subsequently, in 1993 finally enshrined in the Civil Code of the Russian Federation. This law gave people the right to own real estate and manage it. Therefore, it can be considered as the start of the development of the real estate market.

The concept of the "real estate market" is not legally fixed. Although, in general, it can be noted that the real estate market is a sector of the national market economy, which is a set of real estate objects economic entities operating in the market. Operating entities in the real estate market include participants of production, consumption, and exchange of real estate and market management and mechanisms that ensure the functioning of the market.

The significance of the market for the market economy can be confirmed by multiple explanations, for example:

- At least half of the real estate can be involved in market turnover and bring revenue: rents to owners, income to entrepreneurs, taxes, and fees to the federal budget.
 - A high level of collections to the budget from the real estate taxes and its transactions.
 - The number of workplaces participating in the market (starting from construction workers and finishing real estate agents) decreases the unemployment level.
 - Achieved a high share of the real estate market in the gross national product.
- (Nikulina,2008)

The market is constantly evolving and improving; with the modern technologies, the process of searching variants to buy and buyers to sell become faster due to various internet platforms and applications, for example, “Avito.” This website allows posting all announcements for buying and, selling, renting. It can be used by individuals, real estate agencies, and developers.

Many factors influence real estate prices; the main categories are the location of the estate, if it is close to the centre or not, facilities, the area surrounding the estate, the condition of the estate, availability of public transport. Moreover, the number of living rooms, bathrooms, and size of squares also categorize estate and prices.

With the modern way of life, people usually prefer to live in big cities in flats or apartments, with quick access to all necessary stuff such as grocery shops and pharmacies, schools and kindergartens close to the residence, the renovation of the old apartments in good areas is also a trend. In small cities, it is becoming more and more popular to build a house or buy.

2 Objectives and Methodology

2.1 Objectives

The goal of the bachelor thesis is to assess the Russian estate market with the basis of Saint Petersburg. The practical part is analysing the sensitivity of prices in the primary market to economic indicators and the affordability index for the population of Saint Petersburg to buy real estate.

The theoretical part aims to provide a logical sequence of basic terms and concepts of the real estate market, its types, and its environment. This part covers the definition of real estate, Russian deviation of lands, variety of real estate market objects, market participants, the government ways of participation including the taxation of estates, support of buyers, banks' services in the real estate market.

The analysis of the Saint Petersburg real estate market will be done by implementing the regression model to determine how economic indicators influence the price for the square meter in the real estate market and analysing the availability of the estate in primary and secondary markets in Saint Petersburg in the last six years. Main aims:

- Estimating the dependence of price from economic indicators in regression analysis
- Evaluation of the prepared regression model through regression analysis
- Analysing the affordability of buying real estate in Saint Peterburg according to the salary average salary in the city

2.2 Methodology

This bachelor thesis consists of two parts: the theoretical and practical parts. The theoretical part describes the basic concepts related to the Russian real estate market. The resources used to prepare the theoretical part are Russian legal acts, real estate topic textbooks, specialized publications, researchers in the real estate sphere, other written or online sources. All resources were selected using the inductive method of research and index analysis related to the topic.

The practical part is separated into two spheres of analysis the regression analysis method and the standard UN-HABITAT method of calculations of affordability indexes of real estate. The data used in the practical part was collected from various online specialized statistic resources. The analytic part did calculations with Microsoft Excel, using the ordinary pack and special analytic pack that gives functions to implement regression analysis. The time used for the analysis is six years (2016–2021). The regression analysis is evaluated with the gained knowledge during the university education. The UN-HABITAT method of affordability was learned from additional resources and verified according to them.

Regression analysis is a method of studying the statistical relationship between one quantitative dependent variable related to one or more independent quantitative variables. The regression model expresses the relationship between analyzed variables. The regression model is a mathematical function prepared during the regression analysis using statistical data of the dependent and explanatory variables. The regression model is represented as a linear equation:

$$y = a + b_1x_1 + b_2x_2 + \dots + b_kx_m + \varepsilon \quad (1)$$

y – the dependent variable

x_1, x_2, \dots, x_m – independent variables

b_1, b_2, \dots, b_k – partial regression coefficients

a – the meaning y of in the situation when all independent variables are equal to 0

ε – the random variable calls the error term and represents the variability in y which the provided linear equation cannot explain that

The dependent variable (y) is variable that is being predicted. Independent variables (x_1, x_2, \dots, x_m) are all variables used to predict and calculate the dependent variable. Partial regression coefficients (b_1, b_2, \dots, b_k) and a are results of the regression analysis that helps to explain how the independent variables influence the dependent variable and analyze it.

Regression analysis is related to correlation analysis, which measures the strength of the relationship between two or more variables. Correlation and regression analyses both study relationships among variables but from different angles and complete each other. The correlation analysis should be done first to provide the existence of a relationship among dependent and independent variables and avoid strong relationships among independent variables (that is also called multicollinearity).

The UN-HABITAT method of affordability is a method that calculates the affordability of purchasing an estate for the population using the average salary rate and the average price for the apartment. The basic formula for the affordability index by the UN-HABITAT:

$$i_a = \frac{\textit{median home value}}{\textit{median annual household income}} \quad (2)$$

However, median values are not widespread in Russia, so the formula was interpreted into formula using the average values:

$$i_a = \frac{\textit{average estate price}}{\textit{average annual household income}} \quad (3)$$

The formula in the full version of the affordability index is using the size of apartments, the average price for 1 square meter, the number of working members in the household, average salary, and amount of months in the year.

$$i_a = \frac{\textit{average estate price for 1m}^2 \times \textit{size of the housing by standard}}{\textit{average montly salary} \times \textit{number of working memebers} \times 12} \quad (4)$$

3 Literature Review

3.1 The Movable and Immovables

All properties can be categorized by mobility into two groups Movable and Immovable due to §130 of the Civil Code of the Russian Federation. According to §130 of the Civil Code of the Russian Federation, immovables are objects that cannot be shifted without causing enormous damage to their purposes, including buildings and structures. Immovable properties include flats, houses, parts of buildings, and parking garages for transport vehicles. The law can also consider some properties as immovables that do not match the definition provided in §130 of the Civil Code, such as air-borne and sea-going vessels and inland navigation ships that are obliged to state registration according to §33 the Merchant Shipping Code and §16 Code of Inland Water Transport of the Russian Federation.

All other properties that are not related to the immovables by the law are movable things, including money and securities. In contrast to real estate, the movables are not connected to the land and can be easily moved to another place that is not causing changes in properties, such as pieces of jewelry and home furniture. Things that can move by themselves are also movables - animals, cars. (Sukharev,2007) Exceptions also can be established by-laws; for example, advertisement constructions placed on parcels consider as the movables due to specific terms of placement and possibilities of dismantling at the end of the contracts without disproportionate damages according to the Resolution of the Presidium of the Supreme Arbitration Court of the Russian Federation of July 15, 2014, N 5798/14.

3.2 Land Composition in the Russian Federation

The territory of the Russian Federation is globally well-known as the biggest and takes around 17,130,000 km² and requires regulations. That can create the idea about a massive amount of real estate, although due to federal laws, all lands can be used with the established purpose or with additional established purposes. The state divides all areas into seven categories to use and describes them in §7 of The Land Code of the Russian Federation:

- **Agricultural-purpose land**
By the provided definition on §7 The Land Code of The Russian Federation, lands that have been granted and intended for farming production, fostering protective stands, scientific research purposes. It includes instruments required for the whole operation circle of mentioned above directions, such as in-farm roads, transmission lines, pipelines, bodies of water, houses, and constructions.
- **Land of localities**
All areas are deemed for the construction and development of urban and rural localities. The state establishes boundaries among individual, legal, and municipal entities that should be taken into consideration and may not be crossed and overrun according to §83 The Land Code of The Russian Federation.
- **Land of special purposes**
Areas are used to provide and support industrial goals, power productions, communications, transportation as roads, railways, and lands for defense, lands for space activities, and all are listed in §87 The Land Code of The RF.
- **Specially preserved territories land**
Territories possessed by the specific and valuable significance such as good health conditions required natural, historical, and cultural conservation. All areas need protection and support from the state. Their importance can be grouped by regional and federal significance. (§94 The Land Code of The Russian Federation)
- **Forestry land**
The definition given in §101 The Land Code of The Russian Federation claims that forestry lands consist of lands covered with the forest plant and lands purposed for restoration.
- **Water stock land**
According to the category's name, water stock areas whose surfaces are covered with water such as rivers, lakes, seas, and oceans. It also includes facilities built on these zones, for example, hydroelectric stations. (§102 The Land Code of The Russian Federation)
- **Reserve land**
The state has a land fund that is not granted to anyone for exploitation and can be used only after changing the land status to another category. (§103 The Land Code of The Russian Federation)

The below pie chart represents land fund distribution by land categories according to the State (National) Report on The State and Use of Land in the Russian Federation in 2020, representing that only 1.2% of Russian land is intended for the land of localities.

(The State and Use of land in the Russian Federation,2020)

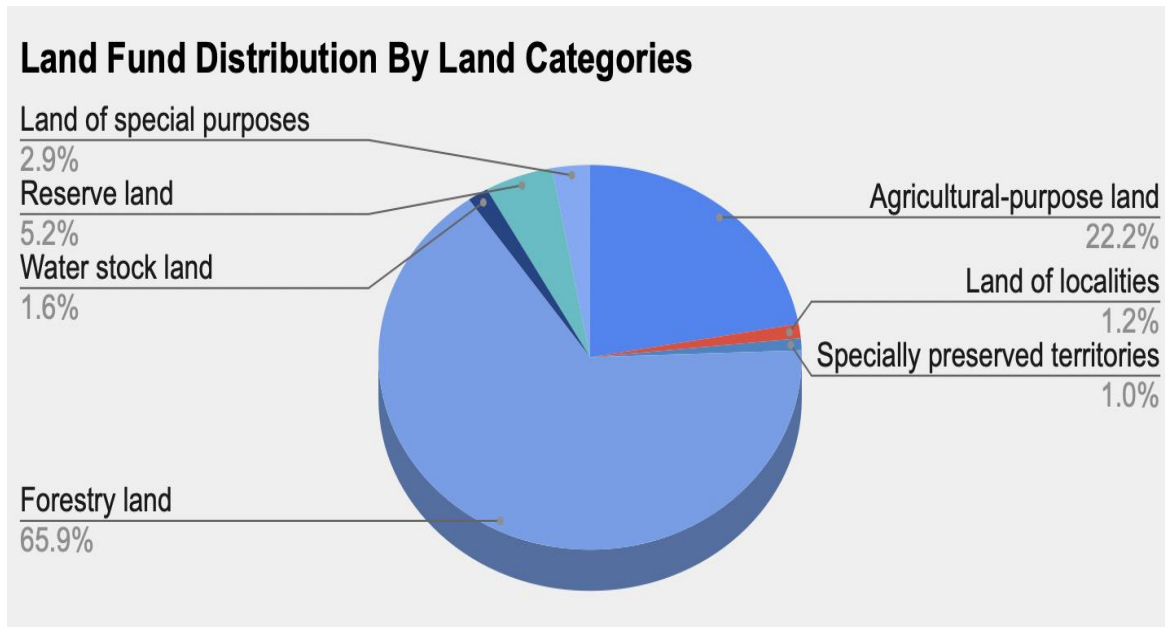


Figure 1. Land Fund Distribution (own source)

3.3 Classifications of real estate objects

Many indicators can categorize immovable objects; one of them is the origin of immovables:

- Natural objects- all estate that was not touched by humans or, in other words, were created by nature, for example, land, perennial plantations, and subsoil areas.
- Artificial objects- results of human activities and labour. It includes residential premises, commercial and public estate.
- Artificial object with a strong connection with nature- all objects created by humans but cannot operate without nature, such as reclamation and irrigation facilities and swimming pools. (Asaul, 2013)

3.3.1 Land and Land plot

A land is a natural object protected as the essential component of nature, a natural resource used as a means of production in agriculture and forestry, and the basis for economic and other activities on the territory of the Russian Federation. - §1 of The Land Code of the Russian Federation.

The land plot is a part of the earth's surface with a fixed dispatch, area, location, intended status, and other characteristics reflected in the state land cadastres and documents of state registration of land rights. The boundary of the land plot is fixed on the plans. It can be divisible and non-divisible. Divisible plots can be separated into independent plots of land.

The main difference is that land cannot be the subject of disposition and the object of registration. So, when the word land is used in the federal codes, not in the meaning of the natural resources, it means a combination of land plots. In the §6 of The Land Code of The Russian Federation mentioned that the objects of land relationships can be:

1. Lands as a natural facility and resources
2. Plots of land
3. Parts of plots of land (§6 The Land Code of The Russian Federation)

3.3.2 Residential premises

Residential premises are real estate properties that meet the established sanitary and technical standards, regulations, and local law requirements. Residential premises can be declared as unfit for habitation due to emergency conditions. They can be subject to demolition or reconstruction. (§15 The Housing Code of the Russian Federation) The Housing Code of the Russian Federation classifies three groups of residential premises:

- **Residential (private) building, parts of residential building**

The private building is an exclusively characterized building, which comprises of rooms, as well as auxiliary premises, required to meet citizens' domestic and other needs related to their living in such a building.

- **Apartment, part of an apartment**

A property is a structurally separate room in apartments buildings that provides

access to common areas in apartments that consist of one or several rooms required to meet citizens' domestic and other needs related to their living in such a building.

- **Room**

Room is a part of residential premises such as residential buildings and apartments used as a place of direct residence of citizens. (§16 The Housing Code of the Russian Federation)

3.3.2.1 Primary and secondary estates

By way of ownership, all residential properties can be of two types: primary and secondary. The primary estate includes only properties that clients buy directly from developer companies. The secondary group includes properties whose ownership rights have already been transferred to other individuals and legal entities. The average prices for the primary estate are usually higher than for the secondary estate; however, both had a considerable growth for the last 20 years. The graph below shows the difference between prices for one m² in primary and secondary estates and changes in the last 20 years. The data is average among all regions in Russian Federation and includes all quality types: elite, improved, average, and low-quality flats provided by the Russian Statistic office.

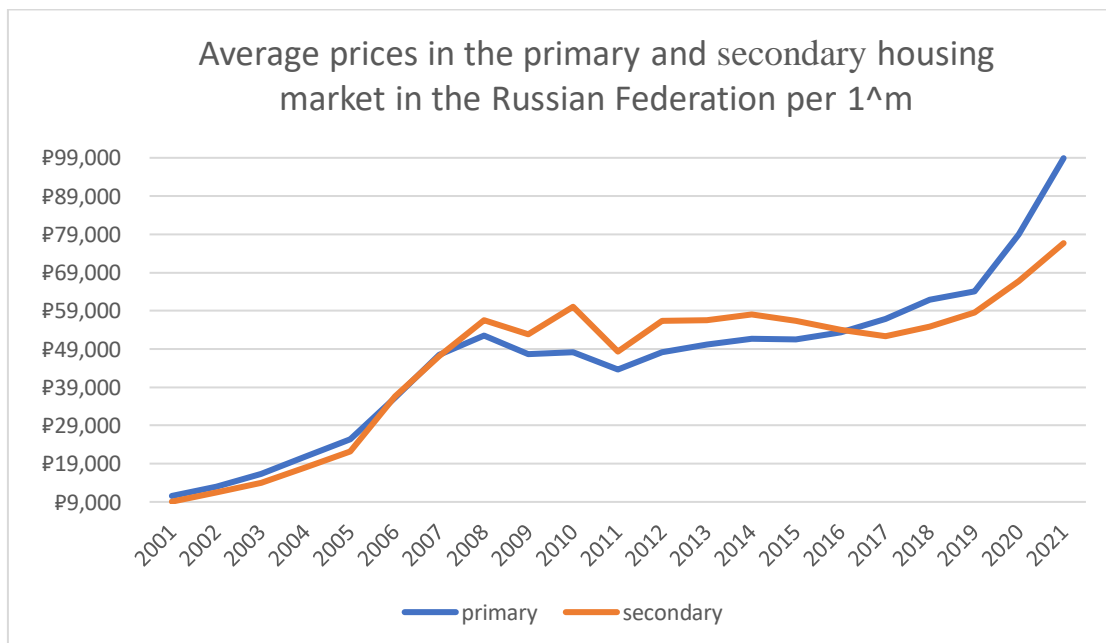


Figure 2. Average price for 1m² in Russia (Russian Statistic Office)

3.3.3 Non-residential properties

Non-residential or commercial estate properties incorporate premises, buildings, facilities, and plots, that are not purposed for the residence and pointed for generating a profit by carrying on business or renting the domain out. The intended purpose of use can be trade-related for shops for goods' selling, clerical - offices for companies' back-office work and offices for arranging meetings with clients, industrial for allocation of production equipment and storage of raw materials, semi-finished products, finished products, and social such as sport and medical centres.

3.3.4 Capital construction objects

Capital constructions objects or constructions are buildings, structures, and objects that have not been completed except for non-permanent buildings and improvements to the land plot. (§1 of the Urban Planning Code of the Russian Federation) Because it is straightly related to the land, construction is real estate according to the mentioned definition of immovables in §130 of the Civil Code of the Russian Federation. Objects change the status of constructions to the accomplished building after signing the certificate of completion; without this certificate, the operation of this estate is prohibited. (§53.7 of the Urban Planning Code of the Russian Federation)

3.3.5 Apartment Building

An apartment building can be considered as unified and integral real estate. It can include residential and non-residential premises. Depending on the number of floors, apartment buildings divide into low-rise houses (up to 3 floors), multi-story buildings (from 4 to 9 floors), high-rise buildings (from 10-20 floors), skyscrapers (from 20 floors). (Asaul, 2013)

3.4 Ownership for real estate

There are two kinds of real estate ownership state and privately owned. For state-owned properties, the regulations are implemented by Russian municipal and state authorities. Ownership implies the right to own, dispose of, and adequately use real estate for purposes and within the limits that do not abuse the rights of owners and compliance with

confinements. The estate owner concentrates all rights for the estate. (§209 The Civil Code of the Russian Federation)

3.4.1 State Registration of the real estate

All real estate is obliged to the state enrollment into the Unified State Register of Real Estate through a legal act of recognition and confirmation of the appearance, change, transfer, termination of the right to a particular person to immovable property or the determination of such a right and the acquisition of real estate. Therefore, the state registration of the right in the Unified State Register of Real Estate of the Russian Federation is the only proof of the existence of the registered right and can only be challenged in courts.

3.4.2 The Unified State Register of Real Estate of the Russian Federation

The unified state register of real estate is the storage of documents related to real estate registration, ownership, limitation of ownership for real estate, detailed descriptions of boundaries and areas, cadastral maps, and books of assessments of the estate documents. It includes all kinds of areas and estate. The information is available for people. In each territorial subject of Russia, there is a federal service for State Registrations, Cadastre, and Cartography. (§7 The Federal Law on State Registration Of the Russian Federation)

3.4.3 National system of spatial data

The way of operation of The Unified State Register of Real Estate is old fashion, an enormous part of documents is still stored only on paper, the amount of stored information is immense, and still, there are blind zones for the State that cause many arguments. For example, according to the research from June 1, 2020, more than 23 million land plots did not have established boundaries, and 48.3 million real estate objects existed without information about owners. For the regulation of appeared situation, the Russian government published the resolution N2148 from December 1, 2021, about approving the state program “National system of spatial data.” The program plans to decrease the gross value added for a wide range of economic sectors and improve the entrepreneurial climate for attracting more investors by solving many problems of the State Register:

- limited usage of modern technologies such as contemporary Russian geoinformation technologies
- standardization of measurement methods and data storing and collection in all territorial subjects
- low rates of collection and updating of spatial data
- lack of information about additional layers of data (Resolution Government of The Russian Federation No 2148)

3.5 Real estate Market

The concept of the "RE market" is not legally fixed. In easy words, the real estate market is the system of organizational measures that provide the meeting of buyers and sellers to determine a specific price on which there is an exchange of goods - real estate can take place. (Tarasevic, 2000) As in all markets, there are supply and demand in the real estate market. Supply on the RE market is the number of plots of land and other immovables that sellers are ready to sell according to established prices at a particular time. Demand on the RE market is the number of plots of land and other immovables that buyers are ready to buy agreed with established prices at a particular time. (Goremykin, 2007) Demand represents buyers' capacity to pay. (Vasilyeva, 2008) The activity level on the RE market level is determined by the number of deals signed among market participants for a certain period, for example, year, quarter, or month. (Vasilyeva, 2008) The RE market participants are sellers (lessor), buyers (tenants), and professional participants. (T. G. Kasyanenko, G.A. Makhovikova, V.E. Esipov, S.K. Mirzazhanov, 2010)

3.5.1 Seller

Sellers or lessors can be any legal or natural person, or even state representatives, who have ownership rights on the estate who sell or rent out with the purchase or rent contract conditions with the agreed prices. This participant sells the property and transfers ownership rights for buyers' possession. (T. G. Kasyanenko, G.A. Makhovikova, V.E. Esipov, S.K. Mirzazhanov, 2010) Sellers include real estate owners, developers, authorities authorized by the local government. Owners who choose the desirable price they would like to sell when they usually face two possible risks: cheapen and overestimate the actual price.

Owners can operate individually by publishing advertisements in newspapers and on websites. They can be presented on the market by the third party such as real estate agents and brokers that have a client's base and platforms for selling their properties in the short term, possessed by required knowledge in legal aspects of selling, the central aspect that they require a small percentage for their work.

When authorities authorized by the local government are sellers or lessors is much more complicated. The government cannot just put the estate on the market and sell or rent for it, and there are usually organized tenders for land and properties. When it is related to the land for commercial purpose, companies and firms should prepare their projects among which state tender commission will choose the winner with a more suitable and profitable project for the city or region according to the amount of new working place, ecology of the project, the importance for the developing. For the first years, construction companies rent the land, and after accomplishing the estate, construction companies have the right to privatize it for ownership.

3.5.2 Buyer

Buyers or tenants are any legal or natural person or even state representatives who create the demand on the RE market. (T. G. Kasyanenko, G.A. Makhovikova, V.E. Esipov, S.K. Mirzazhanov, 2010) The deal participant who received the ownership rights after signing the contracts and paying the agreed price from sellers. In most times. Buyers are the most important participants on the market. Buyers choose the RE due to their preferences and desires, city areas, sizes of properties, primary and secondary estates. They provide the demand and set trends on the market. Sellers also install prices line according to buyers' paying capacity at the current time.

The goals of buying the real estate can be different: tiredness of renting, desire to have the own property or for kids for providing stability, improve living conditions, and invest the capital into the estate, for selling it later or renting. However, renting is popular more among the young generation due to high prices for RE, the convenience of ready and

decorated estates in immediate areas for working places and universities, and the mobility of place of leaving in case of traveling, moving.

3.5.2.1 Foreign buyers

Russian real estate market is open for foreign buyers equally with citizens. However, there are territorial restrictions for buying land and land plots for foreigners and people without Russian citizenship; it is related to border areas and other specially set territories according to federal laws, in which it is prohibited to buy-in. The second group of limitations is associated with owning the agricultural land. The total foreign ownership cannot exceed 50%, so foreign corporations for farm industries usually do not buy agricultural land, only take lands in a lease for the most extended allowed term - 49 years. (§15 The Land Code of The Russian Federation) The RE market also attracts a sphere for foreign investors, as long-term investments. According to the graph published on the research “Investment Market” from the 3rd quarter of 2021 by Knight Frank, the leading independent global property consultancy in Russia, the pandemic situation caused the rapid decrease of foreign investments. In 2019, foreign investments for RE percentage took around 19% from all investments in the RE market and then in 2020 dropped to - 6%, and in 2021-till 4%. (Knight Frank, 2021)

3.5.3 Professional participants

Professional participants distinguish between institutional and non-institutional actors.

Institutional participants are subjects of the RE market who represent state interests and act on its name. (T. G. Kasyanenko, G.A. Makhovikova, V.E. Esipov, S.K. Mirzazhanov, 2010) It includes state organizations that control and support the RE market, for example:

- Bureau of Technical Inventory- carries out technical accounting and inventory of real estate
- State property management agencies – manage federal properties.
- Courts- all courts that regulate lawsuits connected to RE, such as the Arbitration court
- Federal taxation service- establish taxes for properties and control the on-time payment (Goremykin V, 2007)

Non-institutional participants are subjects of the RE market working on a commercial base. (T. G. Kasyanenko, G.A. Makhovikova, V.E. Esipov, S.K. Mirzazhanov, 2010) They usually work as intermediaries of RE deals providing their additional services for getting the payment, paramount of which:

- Insurance companies- responsible for insurance of RE and its serving.
- Appraiser agencies - help sellers provide the right price due to the market situation, estate advantages, and disadvantages.
- Brokers- assist and consult in resolutions of purchasing, selling, and renting RE issues for clients and providing mortgage loans.
- Real estate agents- licensed RE professionals who represent the client and support his interest during the deal should be hired by brokers. (Goremykin V, 2007)

3.5.4 Real estate activity

Real estate agencies have immense social importance as participants of the real estate market. Renting and selling properties is a complicated juridical process with a massive list of nuances that should be considered, such as preparing contracts, checking owners' rights and documents on it lack criminals reports and foreclosures on chosen estates. Real estate activity includes all operations connected to making civil deals with RE objects and requests on his behalf but at the expense of and in the interested clients. All RE operators can be legal entities or individual registered entrepreneurs with signed hiring agreements with clients. Jobs related to RE are brokers, RE agents, attorneys and dealers, traders. Brokers are leading of mention their obligations consultation according to the market situation, selection, and organization of RE displays, preparation required documents for the deal, assisting in organizing mutual settlements between parties, including all loans and mortgages, documentation of the ownership rights transferring to required according to state laws. An agency working in different conditions is related to the selection of property, and the percentage from the completed deal from 8% to 10% depends on its difficulty and is recommended by the Russian Association of Realtors. The Russian Association of Realtors sets standards and certifies services of RE companies and is represented in all subjects of the Russian Federation. (Asaul, 2013)

3.5.5 Avito

On the Russian market, there is the website “Avito” that is a website of personal announcements, taking the first place according to the websites of this category. (Similarweb) On Avito, clients can not only buy cheap or profitably sell car, new or used clothes, furniture, as well as buy and sell, or rent and sell an apartment and other real estates. Announcements of estates can be published by owners directly or also by RE agencies, for buying, selling and longtime and short time rent. The website is convenient as performing photos, technical descriptions, the possibility of chat online with the owner or a knowledgeable representative. Announcements are checked by the website that gives some guaranty to avoid Internet scammers.

3.5.6 Investor

One of the ways of investment can be RE. Income from the RE assets comes in the forms of tenants' payments and increases the value cost during the period of the owning. The variant with the rent requires much time for the payback period while selling it takes less time depending on the liquidity of chosen property. Properties trading costs a lot, including direct and indirect costs. As investments, it requires analysis of the market, previous cash flows, and future predictions that are impossible. That can cause risks for the misestimation of the property. Investors often add real estate to their investment portfolios. Real estate takes an essential part of the world's wealth. Different players, investors, and fund managers are guided by specialized firms in the RE investment market. Investments in real estate are more attractive for pension funds, insurance companies, and sovereign wealth funds. (Baum, A. and Hartzell, D., 2020)

3.6 Taxation of real estate

All operations with properties are taxable, such as ownership, using, and managing. After money gained on the RE taxes are forwarded to state work, regulations, and investments in central funds. Organizations responsible for collecting taxes and fees and control over the collection of all taxes in time: The Federal Tax Service, Financial authorities, the Federal Financial Monitoring Services, and all municipal representatives of mentioned

services. Sixteen different taxes are taken from legal entities and individuals and categorized into four main categories:

1. One of the categorizations of taxation is subject-related:
 - Taxes are calculated and collected from individuals. Related to tax residents of the Russian Federation staying in the country for more than 183 days and all non-tax residents using their properties to generate revenue.
 - Taxes are calculated and collected from enterprises. All legal entities registered according to Russian legislation, and foreign companies with civil capacities and registered branches.

2. Another categorization of taxes is related to the level of the public administration in the country, and the Tax Code highlight three types:
 - Federal taxes- established by Russian Tax Code and should be paid obligatory in all territory of Russia
 - Regional taxes- established by Russian Tax Code and put into actions subjects laws of Russia and applied only in relevant subjects.
 - Local taxes- established by normative legal acts according to the Russian Tax Code and applied only in relevant municipal subjects.

3. The third categorization of taxation is object-related:
 - Taxes for the estate used for satisfying personal needs and supporting business operations.
 - Taxes paid during buying and selling, letting, renting, and mortgages deals.

4. The last categorization of taxation is division by functional purposes:
 - Land Tax
 - Forest Tax
 - Subsoil Use tax
 - Tax on the reproduction of the mineral and sulfur base
 - Tax on water-air vehicles (Goremykin, 2007)

The amount of money that should be paid calculates with the tax rate and the estate's tax base determined by the cadastral cost, registered in The Unified State Register of Real Estate of the Russian Federation and applicable from January 1 of the year that is the tax period. Tax rates can be different in all 95 subjects of Russian due to differences in developments of regions; however, all of them meet restrictions mentioned in the Tax Code:

Tax rate	<0.1%	<2%	<0.5%
Applicable estate	<ul style="list-style-type: none"> • Residential premises • Capital construction objects • Garages and parking spots • Outbuildings for personal usage (up to 50m²) 	<ul style="list-style-type: none"> • Real estates that cadastral costs exceed 300 million rubles • Specific location of real estate • Specific kinds of estates 	<ul style="list-style-type: none"> • Elite properties • Other estates that not mentioned in the first two groups

Table 1. Tax Rates (§406 The Tax Code of The Russian Federation)

3.7 The Central Bank

The Central Bank is a not profit-making stare organization, implementing the defense and stabilization of the Russian ruble, developing, and strengthening the banking system and financial market of the Russian Federation. The Central bank should report their actions and report to the State Duma of the Federal Assembly of the Russian Federation. (§1-5 Federal Law on the Central Bank) The central bank regulates the total amount of issued loans and can establish one or several interest rates for various operations or pursue an interest rate policy with a non-fixing interest rate that helps in the influencing market. (§36, §37 Federal Law on the Central Bank) The list of functions is enormous and includes developing and implementing the unified state monetary policy, monopoly issuing of cash and equity securities, effective management of state reserves, registering, licensing, and controlling commercial bank organizations. (§3-5 Federal Law on the Central Bank)

3.7.1 Commercial Banks

According to the definitions in §1 of the Federal Law of “Banks and Banking,” commercial banks are credit organizations, credited and licensed by the Russian Central Bank, which has the exclusive rights for providing banking operations. (§1, Federal Law on the Central Bank)

Commercial Banking operations:

- Attraction of funds in deposits
- Opening and maintaining bank accounts
- Bank transfers
- Purchase and sale of foreign currencies in cash and non-cash forms
- Leasing of safe deposit boxes
- Providing bank loans (§5, Federal Law On Banks And Banking)

Bank loans are a certain amount of money that clients borrow from commercial banks for the established period by the contract with the interest rate that depends on the type of loan with regular monthly payments.

Types of loans

- Consumer loans (for personal needs)
- Auto loans (for cars purchasing)
- Microloans (loans for small amount)
- Mortgage and Housing loan

Main Russian commercial credited banks:

- Sberbank (one of the world’s largest banks by assets)
- VTB
- Gazprom bank
- Alfa Bank
- Tinkoff Bank

3.7.2 Mortgage loans

A mortgage loan is a type of bank loan that is purposed to buy a residential property secured by a pledge of real estate. This way of loans is good for banks because pledge

provides to creditors additional protection of their rights. In case of the absence of payments prescribed in the mortgage contract, ownership rights on the estates pass to the ownership of the bank, which after puts it up for auctions and sells it to get the compensation for the borrowed money. The pledge of the property is subject to state registration; the debtor will repay its debt in full since real estate has a generally upward trend and will encourage the debtor to fulfill its obligations on time. Furthermore, some of the obligatory conditions for the loan are insurance of the purchased apartments against risks of damage and deconstructions, insurance of ownership rights, insurance of life and disability of the borrower. For debtors, there are also benefits: obtaining a residential property for use, fixed payments not changeable with the market situation, registration at the place of permanent residence of the borrower and his family members, receiving tax relief in the form of a property tax deduction for individuals.

Objects that can be used as a pledge for mortgage loans:

- Land plot
- Commercial estate
- Residential (private) building, parts of residential building, apartment, part of an apartment, room
- Garage, cottage, garden house
- Constructions
- Air and sea vessel

Purposes of mortgage loans can be:

- Purchasing a finished property
- Construction, reconstruction, an overhaul of real estate object

There are many kinds of mortgage loans depending on terms, interest rates, and payments, for example:

1. Mortgage loan with a fixed interest rate and equal payments (standard or self-absorbing loan).
2. Mortgage loan with a fixed interest rate and a gradual increase in payments.

3. Mortgage loan with a reverse annuity (a fixed interest rate and a gradual decrease in payments)
 4. Mortgage loan with a "ball" payment (loan for long term, for example 30 years, with fixed interest rate, the main point of this loan contract that the repayment of the principal amount of the debt begins after a certain period)
 5. Mortgage loan with linear loan repayment
 6. Mortgage loan with an adjustable interest rate and a gradual increase in payments.
- (Kuznetsova,2020)

3.7.2.1 Mortgage interest rate

The interest rate is the amount of money paid for using borrowed money. The rate can vary depending on down payments (more significant amount of down payment = less borrowed money = less interest rate) and loan terms (longer-term = increase the number of interest payments to the bank). The provided line graph shows the highest average mortgage interest rate in the last ten years was after the start of the Russian financial crisis in 2014-2015. Prices went down on Russian ruble due to anti-Russian economic sanctions because of incidents in Ukraine in 2014. In 2015 the average interest rate achieved 13.4%; after there is a steady decrease and improvement in the real estate market, that gives more opportunities for the population.

Mortgage Loan Interest Rate

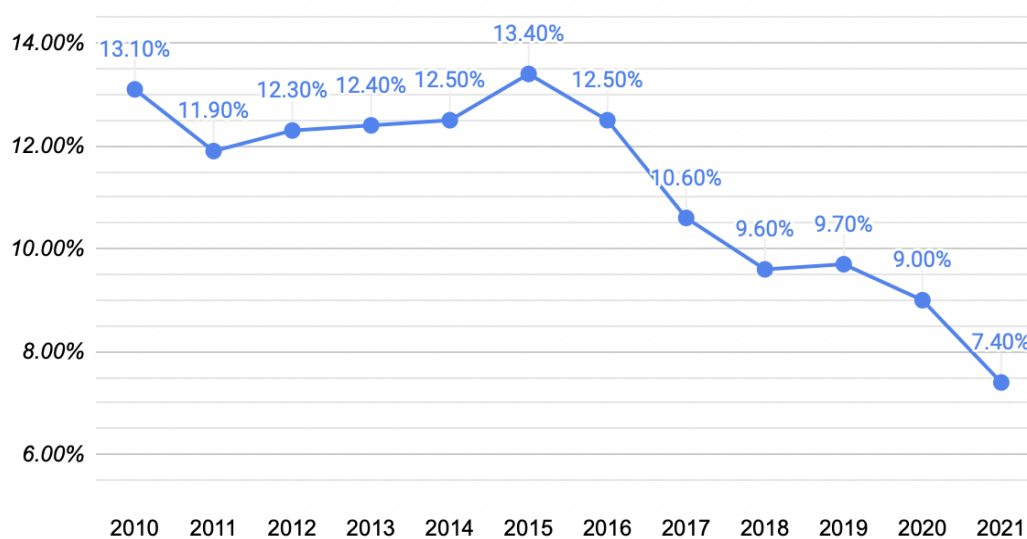


Figure 3. Mortgage interest rate In Russia (Russian Statistic Office)

The interest rate also depends on the key rate of the central bank. The key rate is the primary monetary policy instrument to stabilize inflation. The minimum percentage on which commercial banks can loan money from the central bank influences many spheres. (Resolution of the Central Bank of Russia) With the decrease of the key rate, loans are more available when deposits -less, it provides economic growth, increases purchasing power, and increases the inflation rate. The changes in the key rate represented on the below graph. (Garant.ru) It shows the highest point as well in 2014; due to the complicated economic situation, the central bank started to stabilize the economics. From September 2020, the central bank is increasing the key interest rate to decrease the inflation rate and lead it to 4% that reached 8.73% in January 2022. The central bank considers that increasing the key interest rate should tentatively help to get the inflation rate around 5.0-6.0% in 2022. However, it will cause an increase in the mortgage interest rate.

Key Interest Rate

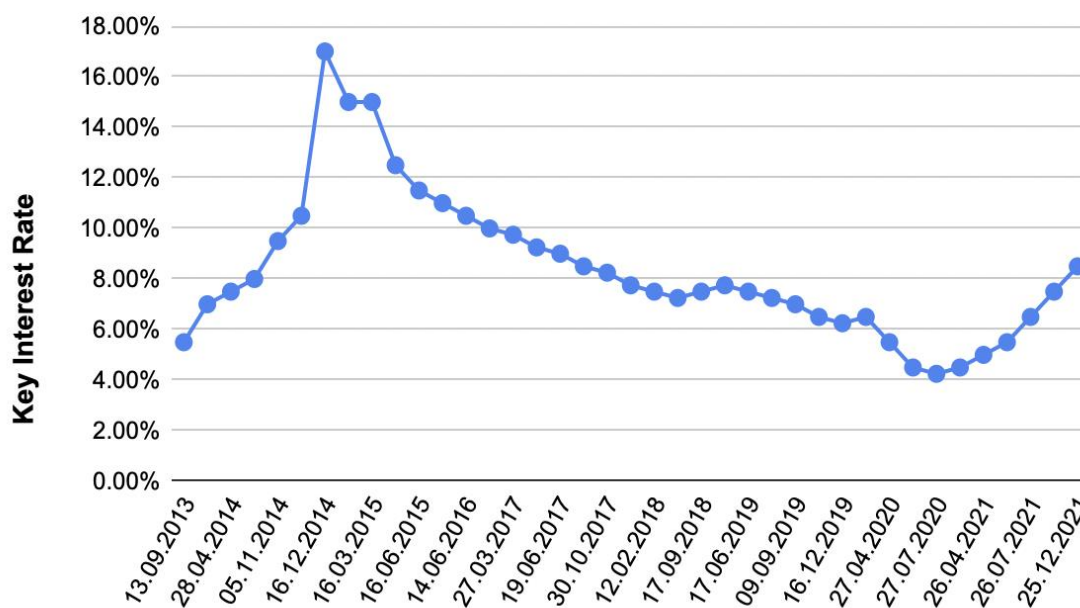


Figure 4. Key rate statistics (Bank of Russia)

3.8 State support programs

As can be considered from figure 3, the mortgage interest rate has decreased since 2015. One of the main reasons for this change is that the state started to be more concerned with the problem of high-interest rates for mortgages that made the buying of real estate less

affordable and attractive for the population. As a result, the state created several state programs to support citizens and developers that provided lower interest rates for mortgages and decreased the average on the overall market.

Preferential mortgage

With a mortgage rate of up to 7%, the state program is valid for all adult citizens of the Russian Federation without any age and marital status. It can be used to buy an apartment in a house under construction, purchase finished housing from the developer, construct a private house under a contract, purchase a land plot with further construction of a house. The primary condition is that the loan amount cannot exceed 3,000,000 rubles, and the down payment should be at least 15% of the estate's price.

Family mortgage

A family mortgage is a mortgage with an interest rate of up to 6%, available for families in which the first child or subsequent children were born between January 1, 2018, and December 31, 2022, families with a disability, and families with adopted kids with the date of birth from January 1, 2018, to December 31, 2022. The long-term loan (up to 30 years) and the minimum down payment is 15% of the estate's price. It can be applied to all kinds of estates in primary and secondary markets. The advantage of this program is that a family mortgage can be used to refinance an existing mortgage loan at a reduced rate (up to 6%) with fulfilling one of the mentioned conditions.

Far Eastern mortgage

This mortgage is working only for estates in the Far Eastern Federal District (colored in red color on the map of Russian districts). Moreover, this kind of mortgage can be provided only for young families (where both partners are below 35 years old), for citizens above 35 years old with kids up to 19 years old) for participants of the program "Far Eastern hectare" (a program where the state provides free land plots for citizens in the Far Eastern Federal District). The main advantage of the Far Eastern mortgage is the interest rate up to 2%, with the minimum down payment being 15% of the estate's price and the term up to 20 years. (Unified Information System for Housing Construction)



Figure 5. Russian districts map-Far Eastern District (source Wikipedia)

4 Practical part

The practical part will analyze the situation in the primary real estate market of Saint Petersburg. The analysis is divided into two parts. The first one is checking the dependence and sensitivity of the price for primary estate on the chosen economic rates through multiple regression. The second will check the affordability of purchasing the primary estate using the standard UN-HABITAT method of calculations of affordability indexes of real estate.

4.1 Introduction to Saint Petersburg

Saint Petersburg is a federal city (§1, State Saint Petersburg Charter) and the second-largest city in Russia after Moscow. According to the last report of the Russian statistics office from 1 January 2021, the population is 5,384,200 people. (Russian Statistical Office) The city is in North-western Federal District, marked with number 1 in Figure 5. Saint Petersburg is well known as the cultural capital of Russia due to its enormous historical and cultural importance to the country. The city was founded in 1703 by Emperor Peter I. He was a big fan of ships and navigations and Europe. Peter I wanted to create a new cultural capital to welcome more foreign guests by sea as Saint Petersburg is scoured by the Gulf of Finland, which opened the easier way to Europe for Russia. Moreover, the city is attractive for tourists to visit many sightsees and museums such as world-known the State Hermitage Museum, Grand Peterhof Palace, Catherine Palace and Park, Faberge Museum. Many people move from different Russian cities and other countries because of tremendous working and studying opportunities.

4.2 Regression analysis

Regression is the relationship between two or more variables where one is dependent and is being predicted, and the other are independent variables used for predictions. Regressions can be simple (linear) with one variable and multiple with more than one independent variable. Multiple regression will be used to analyze prices for the primary estate market. The regression model describes how the dependent variable is related to independent variables and helps predict of the dependent variable in case of changes in

independent variables. The equation represents the regression model in multiple regression:

$$\boxed{y = a + b_1x_1 + b_2x_2 + \dots + b_kx_m + \varepsilon} \quad (1)$$

where:

y – the dependent variable

x_1, x_2, \dots, x_m – independent variables

b_1, b_2, \dots, b_k – partial regression coefficients

a – the meaning y of in the situation when all independent variables are equal to 0

ε – the random variable calls the error term and represents the variability in y which the provided linear equation cannot explain that

4.2.1 The dependent variable

For the dependent variable was chosen the price for one square meter for primary estate. The using data is average price for 1 m^2 in quarters (y in Figure 6) from 2016 to 2021 in Saint Petersburg. The used data is from the information and analytical channel BN.ru that is specialized in real estate in St. Petersburg and the Leningrad region. (BN.RU)

4.2.2 Independent Variables

The price of apartments depends on many factors. However, the author of the thesis is interested in checking the dependency or response of the average price for the 1 m^2 on the primary estate market on economic measures and how these changes supposedly influence the price. For the analysis, five variables were chosen and used their average meaning in quarters that were calculated with the monthly data for each variable:

- Average salaries in St. Peterburg (the column x_1 in Figure 6) – the average amount of money earned by workers in the chosen for analysis city, according to the GOGOV statistic portal

- Inflation rate (the column x_2 in Figure 6) – the inflation rate represents an increase of the general level of prices for goods and salaries (represented in percentages)
- Mortgage rate (the column x_3 in Figure 6) – a mortgage is a popular way of buying the estate; the mortgage rate also influences the market - the analysis used average mortgage rates for the primary market for proper calculation and represented in percentages.
- Oil price (the column x_4 in Figure 6) – the Petroleum industry is a significant economic resource for Russia; oil money makes around 40% of the state budget revenues. The price is in American dollars for 1 barrel of oil.
- Ruble exchange rate for 1\$ (the column x_5 in Figure 6) – the Russian economy is sensitive to the changes in the exchange rate. The increase of the rate causes the growth of cost of production in majorities industries

4.2.3 Used data

For the regression calculation, Microsoft Excel was used with the analytic pack. The chosen period is six years, and data was collected on average for each quarter from 2016 to 2021. So, for calculations, 24 samples will be used. Figure 6 represents collected data that is chronologically organized. All variables used in the author's calculations are numerical data.

date	y	x1	x2	x3	x4	x 5
Q1-2016	100957	45476.66	8.36	13.4	35.08	75.23
Q2-2016	99143	48270	7.34	13.37	46.97	65.91
Q3-2016	101680.67	47253	6.82	13.13	46.98	64.61
Q4-2016	103118.67	53861	5.74	12.88	51.13	63.01
Q1-2017	101049.33	50190.33	4.62	12.7	54.7	58.72
Q2-2017	100674.67	54317	4.19	11.63	51.04	57.09
Q3-2017	100577	52587.33	3.37	10.91	52.21	59.01
Q4-2017	100405.33	60189.66	2.58	10.3	61.53	58.4
Q1-2018	101188.33	58783.33	2.26	9.65	67.16	56.79
Q2-2018	102252.33	59795	2.38	9.45	74.79	61.93
Q3-2018	103961	57678.33	2.97	9.13	75.97	65.54
Q4-2018	105854.33	64642.33	3.88	9.17	68.12	66.51
Q1-2019	110071.33	59874.66	5.17	9.66	60.4	60.4
Q2-2019	113033	63197.66	4.99	10.09	68.34	64.53
Q3-2019	115643.66	60887	4.3	9.62	62.11	64.59
Q4-2019	117945.33	68982.33	3.45	8.84	62.36	63.73
Q1-2020	121003	66587.66	2.43	8.03	51.03	66.5
Q2-2020	125170	65685.66	3.11	6.85	33.27	72.12
Q3-2020	127443.33	66477	3.54	5.97	43.38	73.6
Q4-2020	141323.66	74885.66	4.44	5.92	45.25	76.24
Q1-2021	152662.66	71093.33	5.55	5.87	61.05	74.37
Q2-2021	169546	76502	6.01	5.79	68.99	74.25
Q3-2021	178782	72697.33	6.86	6.03	73.19	73.47
Q4-2021	183895	73517.66	8.31	6.02	79.77	72.64

Figure 6. Data used for the Regression Analysis (own source)

4.2.4 Correlation Matrix

The first step in making the regression model is to check the correlation among variables. The correlation (R) is a descriptive measure of the power of linear association between variables. The correlation range is between -1 and 1; the closer the value to -1 and 1, the better. A negative correlation ($-1 < R < 0$) means an increase in one variable will cause a decrease in another one. A positive correlation ($0 < R < 1$) crates a directly proportional dependency among variables, where an increase in one will lead to an increase in another one and opposite. A zero correlation occurs when $R=0$ and represents no relationships among variables. The correlation between a dependent variable and independent variables helps choose which variables fit more for the regression model. According to the prepared matrix of correlation (Figure 7), there are correlations between y and all chosen explanatory variables. Furthermore, correlations between y and x_1 , x_2 , x_3 , x_4 , and x_5 are significant, so it means that all variables are chosen correctly and adequately, the highest

correlation is with x_1 and $R=0.8143704$, and the lowest is with x_4 and equals to 0.3402543.

The correlation between control variables should be avoided. When the correlation is high ($-0.8 < R$ and $0.8 < R$), it calls multicollinearity and needs to remove one of the variables. In the correlation matrix, we can see a strong correlation between independent variables x_1 and x_3 that is equal to -0.9450298, so one of the variables needs to be excluded for the further preparation of the regression model.

	y	x1	x2	x3	x4	x5
y	1					
x1	0,8143704	1				
x2	0,4009331	-0,10223	1			
x3	-0,800668	-0,94503	0,1525006	1		
x4	0,3402543	0,3975022	-0,072541	-0,309965	1	
x5	0,7027758	0,5418689	0,4708791	-0,601778	-0,161317	1

Figure 7. Correlation matrix (Own source)

To determine which variable is better to use in the regression model, required to check both combinations of variables and compare. Figure 8 shows the regression statistics coefficients of the first combination where the author used x_1, x_2, x_4, x_5 . R square represents the coefficient of determination that shows the goodness of fit for the regression equation. The range of R square is $<0;1>$. In the first combination, the coefficient of determination equals 0.90, which shows that the regression model describes 90%, and the error equals 10%. Therefore, the standard error is 9006.23 reflecting the average distance between actual and estimated y.

Regression Statistics	
Multiple R	0,949997312
R Square	0,902494892
Adjusted R Square	0,881967501
Standard Error	9006,231644
Observations	24

Figure 8. Regression statistics for x_1, x_2, x_4, x_5 (Own source)

Figure 9 represents results for the second combination of x_2 , x_3 , x_4 , x_5 . R square equals 0.943, which means that the error equals 5,7% that is less than in the first combination; the standard error decreased from 79006,23 (Figure 8) to 6918. Therefore, it can be concluded that the second combination provides more accurate results for the regression model. Furthermore, Multiple R is 0.97, close to 1, representing an almost perfect positive correlation.

Regression Statistics	
Multiple R	0,970808445
R Square	0,942469037
Adjusted R Square	0,930357255
Standard Error	6917,995113
Observations	24

Figure 9. Regression statistics for x_2 , x_3 , x_4 , x_5 (Own source)

According to the first correlation matrix and comparison of regression statistics of two combinations, the data set was adjusted, and average salary (x_1) was removed. Figure 10 shows the adjusted correlation matrix.

	y	x2	x3	x4	x5
y	1				
x2	0,40093307	1			
x3	-0,8006678	0,15250055	1		
x4	0,3402543	-0,0725409	-0,3099649	1	
x5	0,70277583	0,47087913	-0,6017777	-0,1613168	1

Figure 10. Adjusted correlation matrix (Own source)

The author is going to prepare 2 regression model with 2 combinations of independent variables: x_2, x_3, x_4, x_5 and x_2, x_3, x_5 . The difference between both combinations is x_4 as according to the correlation matrixes on the Figure 7 and Figure 10 has the least correlation with the independent variable y equaled to 0.3402543.

4.2.5 Regression modeling 1

The regression model was built on independent variables: inflation rate (x_2), mortgage rate (x_3), oil price (x_4), and ruble exchange rate for 1\$ (x_5) (Figure 11). The column “coefficients” represents partial regression coefficients for independent variables (b_2, b_3, b_4, b_5), and the coefficient with y is a from the regression model and equals 226533.45.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,970808445							
R Square	0,942469037							
Adjusted R Square	0,930357255							
Standard Error	6917,995113							
Observations	24							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Value F</i>			
Regression	4	14896339129	3724084782	77,81423599	1,64831E-11			
Residual	19	909314471,3	47858656,39					
Total	23	15805653600						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-Value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
y	226533,4523	46166,86907	4,90684027	9,79199E-05	129905,0848	323161,8198	129905,085	323161,82
x2	9370,973353	1282,737585	7,305448489	6,28433E-07	6686,172732	12055,77397	6686,17273	12055,774
x3	-10198,06363	1166,850564	-8,739819775	4,3974E-08	-12640,30993	-7755,817335	-12640,31	-7755,8173
x4	75,93053036	152,8135383	0,49688353	0,624971608	-243,9118811	395,7729419	-243,91188	395,772942
x5	-901,4729236	523,6685654	-1,721457011	0,101410186	-1997,523827	194,5779803	-1997,5238	194,57798

Figure 11. Regression model (own source)

4.2.5.1 First regression equation

The regression model according to the results represented in the below equation:

$$y = 226533.4523 + 9370.973353x_2 - 10198.06363x_3 + 75.93053036x_4 - 901.4729236x_5 + \varepsilon \quad (5)$$

To see the quality of the prepared regression model, the author prepared estimated y' values according to the estimated regression equation (the regression model without the

error (ε) $y' = 226533.4523 + 9370.973353x_2 - 10198.06363x_3 + 75.93053036x_4 - 901.4729236x_5$). Estimated and actual values of the price for $1m^2$ in the primary estate market of Saint Petersburg are illustrated in the prepared graph (Figure 12), where the blue line represents the actual y values, and the orange line represents estimated y' values. The residual is the difference between y and y' . Residuals can be positive and negative depending on the sign (+/-) responsible for the slope of the deviation. The maximum residual is 16533.99929 rubles in Q1 2019, and the estimated variable is higher than the actual that caused the deviation on the graph. The best estimation with the equation was in Q2 2018, with the minimum deviation equals -62.96375996 rubles.

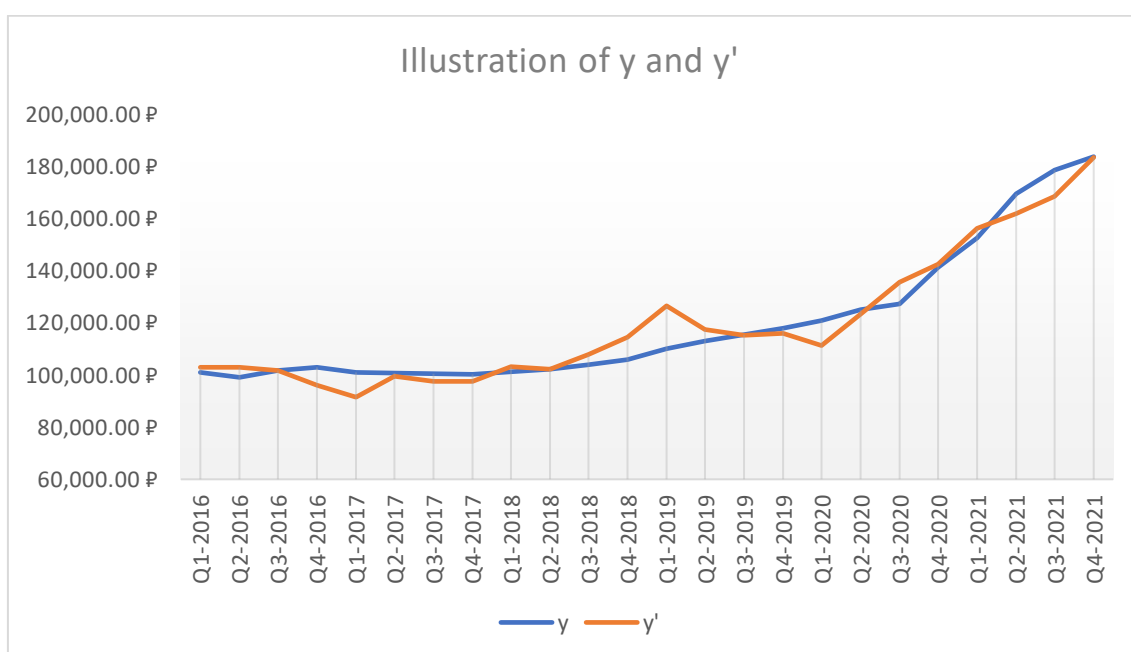


Figure 12. Illustration of y and y' (own source) -1

4.2.5.2 Evaluation of the first model

The implementation of the calculated model can be done through economic verification. The verification explains how specific changes in explanatory variables influence the response variable and is supported by explanations of occurred changes. The author of the thesis provides economic verification of the model using data collected during the regression calculation, and knowledge gathered throughout his studies, especially from the statistics course by Tomáš Hlavsa. According to the above calculations, for the

accurate model required to use four significant variables: an inflation rate (%), a mortgage rate (%), oil price (\$ for barrel), ruble exchange rate for 1\$ (rubles). The prepared regression model is represented in article 4.2.5.1

- **Inflation rate** – as determined by the regression model, the partial regression coefficient b for the inflation rate commensurate to 9370.973353 shows the positive impact of the variable to the explained variable and estimated change in y corresponding to a one-unit (for 1%) change in x_2 , when all other independent variables are held constant with the standard error of 1282.73759 rubles (Figure 11). In other words, the rising inflation rate causes an increase in real estate prices. That change can be explained in two ways. First, the inflation rate represents the general price increase, and the estate is not excluded. Moreover, during the increasing inflation rate, the population is focused on saving their capital from depreciation and investing it in real estate, leading to a rise in prices due to reinforcing demand. The trend is expected and considered as economically verified.
- **Mortgage rate** – as specified by the model, the coefficient b for the mortgage rate equals -10198.06363, represents that the increase of the mortgage rate for 1% will cause the decrease of price for one m^2 in the primary estate market for 10198.06363 rubles when all other explanatory variables are held constant with the standard error of 1166.85056 rubles (Figure 11). This trend is expected as the increase of the mortgage rate causes a decrease in the demand on purchasing the real estate (the higher rate - increase of interest payments to the bank) that forces for reduction of prices. Hence, the trend is considered economically verified.
- **Oil price** – from the results of the regression model calculation, the partial coefficient b for the oil price estimated as 75.93053036 is positive, which means the increase in the oil price brings the growth of the price for the primary estate in Saint Peterburg for 75.93053036 for each 1\$ increase of the oil price when all other control variables are held constant. The standard error is 152.8135383 (Figure 11), the smallest of standard independent variables' standard errors. The trend is not predictable; it seems that there is no direct correlation between real estate prices and oil prices. However, Gennady Sternik Ph.D. of Economics and Management of the Plekhanov Russian University of Economics considers that

the oil price determines practical demands and the cost of housing through several factors, such as macroeconomic factors, including rates of GDP and industrial production. (Sternik, 2009.) The trend also is economically verified.

- Ruble exchange rate – the correlation between x_5 (that represents the Ruble exchange rate) and y is high, equal to 0.70277 (Figure 10), which determines a strong dependence of the price for one m^2 in the primary market, and this control variable is significant. The ruble exchange rate’s partial regression coefficient b is -901.4729236, representing the expected negative impact. The decreasing exchange rate for \$ displays an improvement of the state account balance of payments. The trend is economically verified.

4.2.6 Regression modelling 2

The regression model was built on independent variables: inflation rate (x_2), mortgage rate (x_3), and ruble exchange rate for 1\$ (x_5) (Figure 13). The column “coefficients” represents partial regression coefficients for independent variables (b_2, b_3, b_5), and the coefficient with y is a from the regression model and equals 243875.1086.

SUMMARY OUTPUT								
<i>Regression Statistics</i>								
Multiple R	0,970423339							
R Square	0,941721458							
Adjusted R Square	0,932979676							
Standard Error	6786,495599							
Observations	24							
<i>ANOVA</i>								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Value F</i>			
Regression	3	14884523150	4961507717	107,7264945	1,62736E-12			
Residual	20	921130450,2	46056522,51					
Total	23	15805653600						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t-Stat</i>	<i>P-Value</i>	<i>Lover 95%</i>	<i>Upper 95%</i>	<i>Lover 95%</i>	<i>Upper 95%</i>
y	243875,1086	29646,57857	8,226079378	7,5584E-08	182033,4294	305716,7879	182033,4294	305716,7879
x2	9677,328726	1103,464009	8,769954116	2,73973E-08	7375,543138	11979,11431	7375,543138	11979,11431
x3	-10580,94144	859,5748357	-12,30950581	8,65769E-11	-12373,98312	-8787,89975	-12373,98312	-8787,89975
x5	-1064,377159	400,5785104	-2,657099997	0,015130677	-1899,969289	-228,7850283	-1899,969289	-228,7850283

Figure 13. Regression model 2 (own source)

4.2.6.1 Second regression equation

The second regression model according to the results represented in the below equation:

$$y = 243875.1086 + 9677.328726x_2 - 10580.94144x_3 - 1064.377159x_5 + \varepsilon \quad (6)$$

The thesis author prepared the line graph in Figure 14 to represent the effectivity of the model in comparing the estimated and actual values of dependent variable y. The blue line shows the estimated dependent variable y' according to the prepared regression model without error $y' = 243875.1086 + 9677.328726x_2 - 10580.94144x_3 - 1064.377159x_5$ and actual value of y in orange. The standard error for the second regression model is lower than for the first and equals 6786.495599 Ruble. The maximum residual is in the first quarter of 2019 and equals -17335.29348 ruble, and the minimum is 73.19491057.

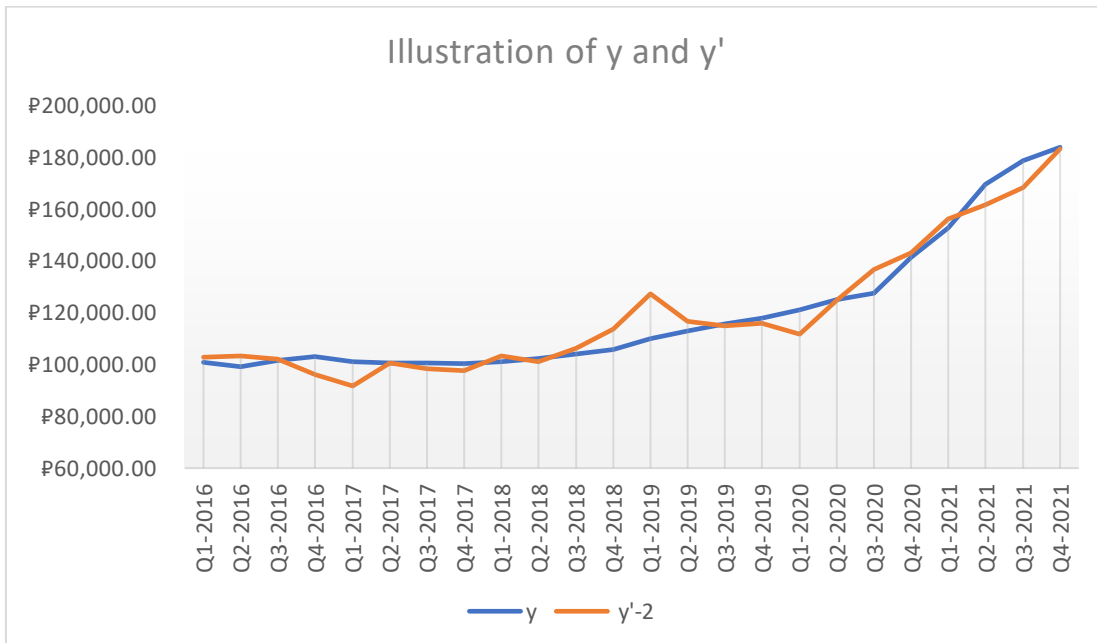


Figure 14. Illustration of y and y' (own source) -2

4.2.6.2 Evaluation of the second model

The regression model implementation, represented in article 4.2.6.1 for the independent variables: inflation rate, mortgage interest rate, and ruble exchange rate for 1\$, is usually done through economic verification. However, the author noticed that the signs of partial

coefficient of independent variables are the same, that the inflation rates' partial coefficients are positive in both regression models when mortgage rates and ruble exchange rate for 1\$ partial coefficients are negative in the first, second regression model. Therefore, the evaluation for the second model is provided only with numeric changes as economic verification is the same as it provided for the evaluation of the first regression model.

- **Inflation rate** – according to the calculation results, the partial regression coefficient ***b*** for the inflation rate commensurate to 9677.328726 shows the positive impact of the variable to the explained variable and estimated change in ***y*** corresponding to a one-unit (for 1%) change in ***x*₂**, when all other independent variables are held constant with the standard error of 1103.464 rubles (Figure 13). The positive coefficient for the inflation rate is expected and economically verified.
- **Mortgage rate** – as the regression model represents the coefficient ***b*** for the mortgage rate equals -10580.94144, represents that the increase of the mortgage rate for 1% will cause the decrease of price for one *m*² in the primary estate market for 10580.94144 rubles when all other explanatory variables are held constant with the standard error of 859.5748357 rubles (Figure 13).
- **Ruble exchange rate** –the ruble exchange rate's partial regression coefficient ***b*** is -1064.377159. The increase in the exchange rate causes a decrease in the price of the primary estate. The trend is expected and economically verified.

4.2.7 Results of the regression analysis

The goal of the regression analysis was to see the specific influences and dependences of economic measures on price for the primary real estate market in Saint Petersburg and to see the inevitable changes that these control variables can cause. The data were collected and organized into a table in Excel in chronological order.

During the preparation of the regression model, the variable “average salary” was removed from the model due to high multicollinearity with a mortgage rate. However, the combination of variables, which includes mortgage rate, provides more prices results

with the coefficient of determination (R square) equals 0.943, when the combination with the average salary variable has a lower coefficient of determination (0.90). Therefore, explanatory variables in the model are inflation rate, mortgage rate, oil price, ruble exchange rate for \$.

To make better calculations, the author prepared two regression models. Both prepared regression models had relative values of R square: for the first model – 0.9424 and the second – 0.9417. The difference is minor, so both models are reasonable; however, the standard error for the first model is higher than for the second. Therefore, the first model is preferable as the coefficient of R square is higher than for the second, and the maximum deviation is lower than for the second model.

Models express the formation of the price for one square meter for the primary estate in Saint Peterburg based on mentioned above control variables. The first regression model interpretation:

The price for 1 m² of primary estate equals 226533.4523 rubles when all explanatory variables are equal to 0 with the estimated error of 6917.99511 rubles. This situation is impossible as all explanatory variables are economic measures that cannot be equal to 0. The increase of the state inflation rate by 1% causes the price increase for 1 square meter by 9370.97335 rubles when all other explanatory variables are held constant. The mortgage rate has a negative coefficient, so a rising mortgage rate of one percent decreases the price for -10198.06363 rubles. The oil price growth to one unit represented in dollars results in the price growth by 75.93053 rubles. The exchange rate's partial coefficient is negative, which brings a drop to the price by 901.47292 when the exchange rate increases on one ruble. These changes work for each variable when all other explanatory factors remain unchanged.

As a result, regression models can show the estimated price for square meter due to changes in economic factors; with knowledge about the real estate market, this calculation makes sense and is explained.

4.3 Analysis of affordability of the residential estate

The housing problem appeared due to customers' low solvency that generally depends on estate prices and customers' incomes. To estimate the level of the affordability of the

estate, UN-HABITAT created a method for calculating and evaluating the affordability index (i_a). The method helps to analyse the current market situation based on income and price. This part of the practice aims to analyse the i_a in Saint Petersburg for primary and secondary for the six years divided by quarters.

4.3.1 Introduction to UN-HABITAT

The United Nations Human Settlements Programme (UN-Habitat) is a unique program founded by the United Nations in 1978 and specialized in providing adequate housing for all and sustainable urban development. The main slogan of the organization is: “For A Better Urban Future.” This commission makes housing analyses and helps create measurements and criteria of the housing profile. The housing profile is a valuable tool for diagnosing the housing situation consisting of a systematic analysis of the housing delivery system. Moreover, House profiles are helpful for the government to find sick points and problems that cause issues in the working process of the residential real estate market and prepare appropriate solutions and political directions.

The UN-Habitat office in Russia appeared in 1989 in Moscow and started an entire operation in 2006 with the signed cooperation agreement about working together with the State Committee of the Russian Federation for Construction, Housing, and Communal Services. The main aspects of the agreement are sustainable urban planning and management, protecting citizens’ rights to housing according to the UN-HABITAT Global Campaign for the Right to Housing, strengthening local governments, providing sustainable financing of the housing sector, monitoring, and publication on the biennial basis of reports on the state of Russian cities. (UN-Habitat official website) The UN-Habitat has different methods of estimating the real estate market situation. The chosen method for the analysis is the Affordability index (i_a).

4.3.2 Affordability index in Saint Petersburg

The affordability of the estate directly depends on the level of solvency of consumers in the market calculated through the ratio of the level of income and estates prices. There are various approaches to the derivation of the affordability index values. The method

used in the practical part is the method provided by The UN-Habitat. Basically, the affordability index is determined by the number of years required for an average family to accumulate funds to purchase an average housing, provided that all household income will be directed to the estate purchasing purpose. The UN-Habitat affordability index formula:

$$i_a = \frac{\textit{median home value}}{\textit{median annual household income}} \quad (2)$$

- **The median value of a home**- the price of the residential estate in relation to which 50% of the available units has a higher price and 50% cheaper.
- **The median annual household income**- the total income of a household compared to which half of all households have incomes above and half below.

However, this formula is not applicable for Russia as median values are not used and data on these measures are not provided, so the Russian Federal target program “Housing” adapted the formula into:

$$i_a = \frac{\textit{average estate price}}{\textit{average annual household income}} \quad (3)$$

The full formula:

$$i_a = \frac{\textit{average estate price for } 1m^2 \times \textit{size of the housing by standard}}{\textit{average monthly salary} \times \textit{number of working members} \times 12} \quad (4)$$

4.3.3 Calculation of the affordability index

The analysis of real estate affordability in Saint Petersburg will be done for primary and secondary markets separately due to differences in prices. The period of calculation is six years divided by quarters. The calculation is provided for the households consisting of 3 people (family with one kid, with two working members) and the housing size is 54 m^2 . The calculations are done in Microsoft Excel. The used data is the average salary rate average price for 1 m^2 for primary estate and secondary estate in Saint Petersburg. The data for the average salary was taken from the Russian Federal State Statistics Service,

and the average prices for $1m^2$ for the primary and secondary estate were collected monthly and averaged by quarters from the mentioned above portal real estate BN.ru. The below image represents used data and results of the calculations according to the affordability index formula:

date	Average salary (monthly)	Household Income for a year (average salary)	Price for $1m^2$ in the primary market	Price for $1m^2$ in the secondary market	Estimated price for the primary estate ($54m^2$)	Estimated price for the secondary estate ($54m^2$)	Affordability index for the primary	Affordability index for the secondary
Q1-2016	45 476.66 ₺	1 091 439.84 ₺	100 957.00 ₺	103 000.33 ₺	5 451 678.00 ₺	5 562 017.82 ₺	4.99	5.1
Q2-2016	48 270.00 ₺	1 158 480.00 ₺	99 143.00 ₺	103 362.00 ₺	5 353 722.00 ₺	5 581 548.00 ₺	4.62	4.82
Q3-2016	47 253.00 ₺	1 134 072.00 ₺	101 680.67 ₺	104 501.00 ₺	5 490 756.18 ₺	5 643 054.00 ₺	4.84	4.98
Q4-2016	53 861.00 ₺	1 292 664.00 ₺	103 118.67 ₺	105 307.33 ₺	5 568 408.18 ₺	5 686 595.82 ₺	4.31	4.4
Q1-2017	50 190.33 ₺	1 204 567.92 ₺	101 049.33 ₺	105 252.33 ₺	5 456 663.82 ₺	5 683 625.82 ₺	4.53	4.72
Q2-2017	54 317.00 ₺	1 303 608.00 ₺	100 674.67 ₺	106 214.67 ₺	5 436 432.18 ₺	5 735 592.18 ₺	4.17	4.4
Q3-2017	52 587.33 ₺	1 262 095.92 ₺	100 577.00 ₺	107 750.33 ₺	5 431 158.00 ₺	5 818 517.82 ₺	4.3	4.61
Q4-2017	60 189.66 ₺	1 444 551.84 ₺	100 405.33 ₺	107 296.33 ₺	5 421 887.82 ₺	5 794 001.82 ₺	3.75	4.01
Q1-2018	58 783.33 ₺	1 410 799.92 ₺	101 188.33 ₺	107 181.00 ₺	5 464 169.82 ₺	5 787 774.00 ₺	3.87	4.1
Q2-2018	59 795.00 ₺	1 435 080.00 ₺	102 252.33 ₺	108 189.00 ₺	5 521 625.82 ₺	5 842 206.00 ₺	3.85	4.07
Q3-2018	57 678.33 ₺	1 384 279.92 ₺	103 961.00 ₺	109 669.67 ₺	5 613 894.00 ₺	5 922 162.18 ₺	4.06	4.28
Q4-2018	64 642.33 ₺	1 551 415.92 ₺	105 854.33 ₺	112 452.67 ₺	5 716 133.82 ₺	6 072 444.18 ₺	3.68	3.91
Q1-2019	59 874.66 ₺	1 436 991.84 ₺	110 071.33 ₺	115 517.67 ₺	5 943 851.82 ₺	6 237 954.18 ₺	4.14	4.34
Q2-2019	63 197.66 ₺	1 516 743.84 ₺	113 033.00 ₺	120 426.00 ₺	6 103 782.00 ₺	6 503 004.00 ₺	4.02	4.29
Q3-2019	60 887.00 ₺	1 461 288.00 ₺	115 643.66 ₺	123 799.33 ₺	6 244 757.64 ₺	6 685 163.82 ₺	4.27	4.57
Q4-2019	68 982.33 ₺	1 655 575.92 ₺	117 945.33 ₺	126 249.33 ₺	6 369 047.82 ₺	6 817 463.82 ₺	3.85	4.12
Q1-2020	66 587.66 ₺	1 598 103.84 ₺	121 003.00 ₺	128 585.67 ₺	6 534 162.00 ₺	6 943 626.18 ₺	4.09	4.34
Q2-2020	65 685.66 ₺	1 576 455.84 ₺	125 170.00 ₺	129 936.67 ₺	6 759 180.00 ₺	7 016 580.18 ₺	4.29	4.45
Q3-2020	66 477.00 ₺	1 595 448.00 ₺	127 443.33 ₺	133 380.67 ₺	6 881 939.82 ₺	7 202 556.18 ₺	4.31	4.51
Q4-2020	74 885.66 ₺	1 797 255.84 ₺	141 323.66 ₺	145 611.67 ₺	7 631 477.64 ₺	7 863 030.18 ₺	4.25	4.38
Q1-2021	71 093.33 ₺	1 706 239.92 ₺	152 662.66 ₺	158 041.00 ₺	8 243 783.64 ₺	8 534 214.00 ₺	4.83	5
Q2-2021	76 502.00 ₺	1 836 048.00 ₺	169 546.00 ₺	173 460.00 ₺	9 155 484.00 ₺	9 366 840.00 ₺	4.99	5.1
Q3-2021	72 697.33 ₺	1 744 735.92 ₺	178 782.00 ₺	174 761.00 ₺	9 654 228.00 ₺	9 437 094.00 ₺	5.53	5.41
Q4-2021	73 517.66 ₺	1 764 423.84 ₺	183 895.00 ₺	173 471.33 ₺	9 930 330.00 ₺	9 367 451.82 ₺	5.63	5.31

Figure 15. Affordability index calculations

4.3.4 Evaluation of the affordability index

This index represents in years how long it is required for a household to save money to buy an estate of size $54 m^2$. For example, in Q1-2016 the typical household with two working members and year income equaled 1 091 329,84 rubles needs 4,99 years to buy the estate. The average affordability index for the last 6 years for the primary estate is 4,38 when for the secondary estate is 4,55. The best rate was achieved in the fourth quarter of 2017 for both markets 3,75 and 4,01, on the last quarter of 2021 the affordability index for the primary market reached the highest point for last 6 years – 5,63 and the secondary

market in the third quarter of 2021 – 5,41. The classification of the index in the market is worldly recognized as:

- 1-3 – affordable real estate
- 3-4 – moderately affordable real estate
- 4-5 – seriously unaffordable real estate
- 5-8 – severely unaffordable

According to the classification of the index, the real estate in Saint Petersburg during the chosen period is serious unaffordable for purchase and complicated in primary and secondary market. Moreover, the primary estate is more affordable due to lower index for the primary estate than for secondary during the chosen period. The below graph represents dynamics of the changes in the affordability indexes of both markets in the analyzing period (Figure 16).

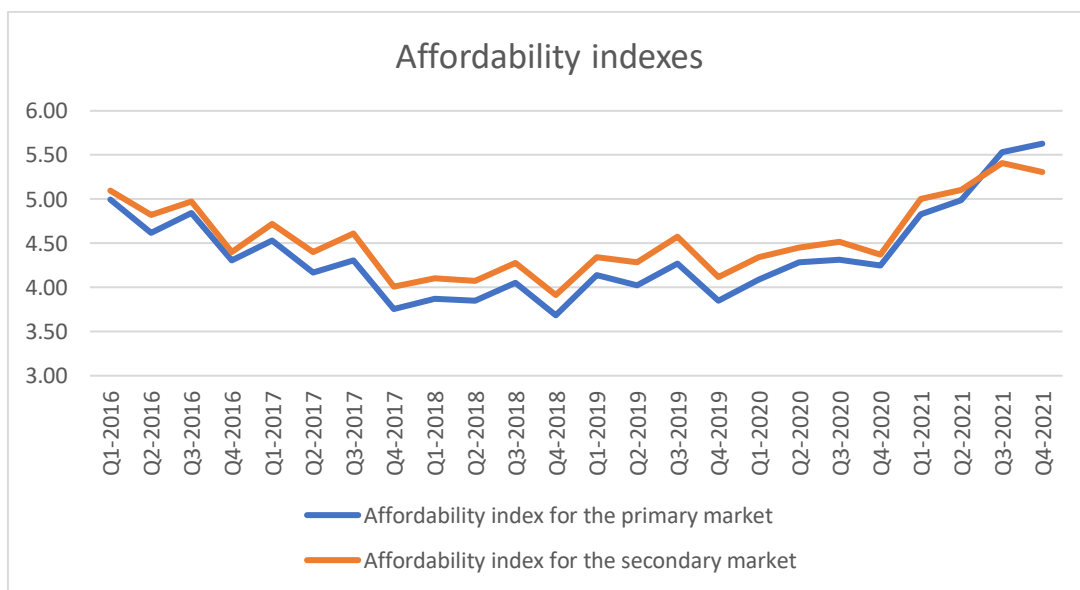


Figure 16. Affordability indexes dynamics (Own source)

This analysis method is useful only for analytics, statistics, and economists who goaled to explore the macroeconomics. That helps the easier model calculate the real estate affordability in different regions to determine prosperous and non-performing regions. However, this methodic is not calculating actual years required for households to buy the estate, as according to the methodic all received income will be put aside for the purchasing of residential real estate, and not including consumer spending that significantly will increase the index and the time required for the purchasing of the real estate. (Rudy, Tropnikova, 2012)

5 Conclusion

The thesis aimed to analyze the real estate market in Saint Petersburg. The analysis was done in two directions. The first was checking the changes in the primary estate market prices due to changes in critical economic values. While the second provides the affordability of buying primary or secondary estate according to the average salary in Saint Petersburg for the standard household consisting of three people, where only two are working.

The regression analysis proved the connection of chosen economic measures with price changes. According to the results of both regression models, the increase of the inflation rate leads to the increase of the price for one square meter of the primary estate, the increase of the average mortgage interest rate on the real estate market for the primary estate causes the decrease of the price, the increase of the Ruble exchange rate reflects in the decrease of the price. The first regression model also showed the oil price has a positive partial coefficient, so the increase of the price. The attached graphs in Figures 12 and Figure14 show the effectivity of prepared models that can be used to predict prices using models and measures of variables.

According to the calculation of affordability indexes with the UN-Habitat method, the purchasing of estates' affordability can be considered seriously unaffordable real estate. That can be considered a problem on the market, so the state support programs for households with kids are required due to lower mortgage rates.

The importance of the real estate market is high for economics and society. Russian real estate market is constantly developing and changing over the years depending on trends and adapting to economic situations.

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