Hedonic Pricing in the Modern Housing Market of the Novosibirsk Agglomeration

Y Kazantsev

1 Siberian Institute of Management – a branch of The Russian Presidential Academy of national economy and public administration, 630102, 102, st. Nizhegorodskaya, 6 Novosibirsk, Russia
E-mail: yyk@inbox.ru

Abstract. The paper is devoted to the search for hedonic markups for residential properties in the Novosibirsk agglomeration in 2020. Method of hedonic regression is being tested in relation to the Russian housing market, based on the experience of similar foreign studies. The object of observation is a typical housing stock, legacy of the Soviet economy and urban planning. The use of hedonic model of pricing for real estate objects is presented in the works of many foreign researchers, but they considered them in relation to local housing markets, which have their own specifics, so their experience is not applicable in Russia. Our obtained results in numerical terms are comparable with similar data of foreign colleagues. This study is methodologically based on the studies’ results of hedonic pricing, obtained by Russian scientists, using materials from the Siberian region. As a matter of fact, these studies were carried out in the early 2000s, and their results related to the early development of the real estate market in Siberia. Hedonic method was applied in the analysis of real estate prices in the Novosibirsk agglomeration in 2020, an attempt was also made to minimize the entire set of factors influence on an object price, focusing on the hedonic markup, such general scientific methods as the system approach as a general methodological principle of the study were used in this work, scientific abstraction, logical analysis, systematization methods, comparative analysis, hedonic regression (Hedonic regression method) was used in the calculations as a kind of hedonic pricing.

1 Introduction

The hedonic trend in economics is not new one. Economists periodically refer to this topic, and the term "hedonism" was encountered in the middle of the 20th century. At the same time, the hedonism economics has not taken shape as a knowledge integral area of the relationship between manufacturer, seller and buyer, although real scientific breakthroughs have been made in some areas. Modern researchers periodically oppose hedonism to utilitarianism, endowing the former with functions of sensory perception (for example, impulse buying), and latter with rational consumer behavior [1]. This Manichaean interpretation should be taken carefully enough, as utilitarianism may be a particular case of hedonic behavior that engulfed large conglomerates of consumers. However, this study does not focus on the similarities and differences between the concepts of “hedonism” and “utilitarianism”.

The Hedonic pricing method has been already proven in the markets of land and real estate [2], tourism and recreation [3], consumer goods [4], mobile phones [5], art [6] and even the commodity market [7]. However, at this very moment, this method can not be recognized as universal one,
because, it has not been tested in all markets yet. It is likely that the widespread adoption of this method is a matter of numerous future research and implementation in marketing practice.

The hedonic model use of pricing for real estate is presented in the works of such foreign researchers as Allan Din, Martin Hoesli, Andre Bender, Marc K. Francke, Gerjan A. Vos, Jos E. Janssen, but the works are considered in relation to local housing markets, which have their own specifics, so their experience is not applicable in Russia, as well as in other countries.

The present study is methodologically based on the results of hedonic pricing studies, obtained by Russian scientists, using materials from the Siberian region [8, 9]. These studies were carried out in the early 2000s, and their results related to the early development of the real estate market in Siberia in the 1990s - 2004. The hedonic method is applied to the analysis of real estate prices in the Novosibirsk agglomeration in 2020 in this paper. In addition, an attempt to minimize the entire set of factors influence on the property price, focusing on the hedonic markup was made.

2. Materials and Methods
The author used such general scientific methods as the systematic approach as a general methodological principle of research, scientific abstraction, logical analysis, methods of systematization, comparative analysis. This work was carried out, using hedonic pricing, more precisely, its variety - hedonic regression (Hedonic regression method). This method is applied to the analysis of prices in the real estate market in the comparison with other studies around the world. The objects’ observation was apartments of typical Soviet-era residential buildings on the secondary housing market in the Novosibirsk agglomeration. In total, two pairs of topographically close areas were compared:

1) Koltsovo science town in the suburb of Novosibirsk and the Berezovoe microdistrict in the Pervomaisky district of Novosibirsk;
2) the Ob HPS microdistrict and the right-bank quarters in the area of transport stop "Gateway", located in the Soviet district of Novosibirsk.

The source of information was the electronic database of residential real estate in Novosibirsk and adjacent territories No. 1 (https://novosibirsk.n1.ru/).

Purpose of the study is to identify the incalculable hedonic factor affecting prices setting in the residential real estate. The hypothesis is formulated as follows - among other factors, the price of residential real estate is influenced by:

a) the area ecological situation;
b) recreational opportunities of the territory.

The scientific significance lies in the application of hedonic pricing and hedonic regression methods to real estate appraisal on the local Russian market. Thus, methodological innovations have been introduced into the practice of assessing the parameters of the residential real estate market.

The practical significance is the study’s obtained results that can be used in appraisal activities and provided assistance to municipal authorities (including those outside the Novosibirsk agglomeration) in planning of the municipality territory development.

This work represents the first stage of market prices study for residential real estate, carried out by comparing data from open sources. The ideology of the hedonic method is based on the following thesis: a buyer considers a product as a set of attributes; theoretically, all attributes are significant, but among them there are less priority ones, and when a deal is made, one or another attribute (or a complex combination of them) is evaluated in terms of the buyer's budget. In other words, the lower price is the lower value of some attribute. Traditionally, the hedonic method is used for real estate appraisal, and in this case, foreign colleagues, who use the hedonic regression method, distinguish mainly environmental attributes among others [10].
Studies using the hedonic regression method are built in the following algorithm:

1) the dwelling is represented by a pragmatic combination of attributes, related to the apartment characteristics itself (s), environment (e) and neighbors (n) - in a broad sense (for example, proximity to industrial facilities, railways, highways, etc.);
2) each of the terms is decomposed into specific attributes; so, for example, the environment can be expressed in significant attributes: e1 - forest, e2 - park; e3 - reservoir ..., so, the attributes are ranked according to their importance for the buyer [11];
3) matching characteristics do not play a significant role in price formation, therefore, the greater discrepancy between specific attributes is the higher their share in the hedonic markup.

Thus, if the characteristics of apartments and buildings (s) and neighboring objects (n) are largely the same, we can assume that the hedonic margin is really formed by environmental factors (e) in this work.

3. Results
The prices were checked for 2-room apartments in panel houses not older than 1990 on March 12, 2020, both five-, nine- and ten-story buildings or non-modern housing, which advantages, firstly, were developed in one way or another the least infrastructure, and secondly was an affordable price. Open sources of information about the housing market is periodically criticized among economists, however, the advantages of such data, are obvious, especially in the real estate market: data on objects for sale are open, provided with descriptive characteristics, such as price justification, which greatly simplifies the researcher's work [12]. In addition, there seems to be no equivalent substitute for objective market information [13].

Two pairs of residential areas in the agglomeration of Novosibirsk were taken for comparison:

1) Koltsovo science town and Beryozovoe microdistrict;
2) the Ob HPS microdistricts and "Gateway".

All prices are given in euros at the exchange rate of the Bank of Russia on the information collection date (https://www.cbr.ru/).

We should turn to the first pair. There are 10 apartments for sale that meet the above criteria, at Koltsovo and on Tsentralnaya street in the science town Koltsovo and, 15 apartments are on the streets of Beryozovaya, Prishvina, Tvardovskogo, Uchenicheskaya, Shukshina in the "Beryozovoe microdistrict ". Data on the Berezovoye - Koltsovo pair are presented in Table 1.

Table 1. Cost characteristics of 2-room apartments in Koltsovo science town and microdistrict "Berezovoe".

|                | "Berezovoe" | Koltsovo |
|----------------|-------------|----------|
|                | Price, euro | Square, m² | Price 1 m², euro | Price, euro | Square, m² | Price 1 m², euro | Excess, % |
| Max            | 35 300      | 47       | 776  | 43 816 | 54   | 874  | 13   |
| Min            | 24 068      | 42       | 547  | 28 264 | 47   | 601  | 10   |
| Ave            | 30 773      | 44       | 698  | 37 003 | 49   | 760  | 9    |

Source: comp. and calculated by the author using the database: https://novosibirsk.n1.ru/

An important characteristic is the average price per m² of residential property, as it evens out the differences between apartments to some extent. For example, if the total apartment square does not exceed 47 m² in "Berezovoe", then such a square in the science town of Koltsovo on the contrary, is minimal. Thus, the excess of the average price per m² by 9% can be considered a hedonic markup with some reservations.

For comparison of this pair, the prices for 2-room apartments in 9-storey panel buildings are taken into account. In the Ob HPS microdistrict, 14 apartments are exhibited in Berdyshev, Vetluzhskaya,
Table 2. Cost characteristics of 2-room apartments in the microdistricts of the Ob HES and "Gateway".

|                | the Ob HES | "Gateway" |
|----------------|------------|-----------|
|                | Price, euro| Price 1 m², euro | Price, euro | Price 1 m², euro | Excess, % |
| Max            | 36 904     | 766       | 44 433      | 962          | 25        |
| Min            | 27 154     | 601       | 32 091      | 640          | 6         |
| Ave            | 32 446     | 679       | 38 254      | 754          | 11        |

Source: comp. and calculated by the author using the database: https://novosibirsk.n1.ru/

In the second pair of comparable urban areas, the hedonic markup can be 11%.

4. Discussion

It should be determined how significant the markup of 9% or 11% is. We studied the issues of foreign authors, which are carried out by a similar method in different regions of the world. So, they also use the method of comparative analysis. Among the relatively recent ones, we were interested, for example, by the data of Chinese scientists, who found that a generally favorable ecological environment (green spaces, reservoirs), as well as the corresponding "green" view from the window, could increase the cost of housing by more than 7% [14]. Thus, the ordinal values, obtained by them and by us are quite similar (taking into account the difference in the initial data). In [15], the studies’ results by scientists from Germany and Switzerland are given, where it is assumed that the influence of environmental factors can form up to 30% of the cost and they reflect the principle of “fair market value”. On the contrary, researchers of the real estate market in Kazakhstan conclude that the environmental factor is currently of little significance in Kazakhstan, although important for real estate valuation and the value of real estate mainly takes into account many factors (social, economic, etc.) [16].

The principle of residential areas pairs forming for this study should be explained in more detail. On the one hand, Novosibirsk is a young city (founded in 1893), on the other, it is the most populous city in Asian Russia with a population of over 1.5 million. [17]. The mark of 1 million inhabitants in 1970 was passed in Novosibirsk. Urban development in the USSR in the 20th century was carried out on a large scale [18] and stereotyped - from the design of blocks to the finishing of apartments in new buildings. In the Novosibirsk agglomeration, there may be a lot of secondary housing of the same type, which has predominantly identical characteristics, especially such as a typical project, footage, number of storeys, infrastructure of neighborhoods and microdistricts, etc. Application of the hedonic regression method should give obvious results.

In the present study, the choice in favor of micro-districts with ecological and recreational characteristics was made. It is not difficult to find an "ecological" couple in the Novosibirsk agglomeration: the more blocks are removed from the city center, the more pronounced their environmentally friendly image (in this work, this controversial thesis is ignored, since the opinions and judgments of real estate market participants are more important than the truth).

During the Soviet period of its history, the city of Novosibirsk was formed as a large industrial city; some of its residential areas merged into the "industrial zone" ("industrial zone" was a negative jargon, implying not only proximity to industrial enterprises, but also an unfavorable urban environment in every sense). Consequently, the antipode of the "industrial zone" should have become urban areas with a "natural" image. Since the mid of 60th of XX century - the first decade of the XXI century, there was a scientific center - Akademgorodok in Novosibirsk. It is located in a forested area on the banks of the Ob reservoir at a distance of 30 kilometers from the city center and attracts buyers of expensive housing with its complex image - a natural combination of science, culture, pine forest and beach. From a hedonic regression point of view, a complex equation with a large number of variable...
parameters should be constructed. For example, the ecological factor can have diametrically opposite incarnations:

- forest park zones promote health and provide increased recreational opportunities;
- the same wooded areas are dangerous for humans in the warm season due to the danger of a tick infestation - a carrier of encephalitis, Lyme disease and other serious diseases [19].

Therefore, for the purposes of this study, Akademgorodok was rejected because it could not find an adequate match for comparison. By the way, the threat of tick-borne encephalitis and Lyme disease is relevant for residents of all four microdistricts.

Koltsovo science town was founded in 1974 together with the Virological and Biotechnological Center of the State Research Center "Vector". Since 2005, Koltsovo has been a part of the Novosibirsk Region as an independent urban district with a population of at least 17 thousand people in 2019. The Koltsovo science town is an important link in the scientific, technical and economic system of Novosibirsk along with the scientific institutions of the Academgorodok, despite the formal exclusion from the city of Novosibirsk [20].

It is important for this study, that this urbanized area is located at a distance from the city of Novosibirsk, although it actually consists of its agglomeration. Residents of the Koltsovo science town work at enterprises and organizations of Novosibirsk, and also use the city's cultural and educational infrastructure. An important obstacle to making a decision to buy residential real estate in Koltsovo is the unresolved transport problem: the remoteness from Novosibirsk itself is aggravated by the low traffic capacity of motorways from the science town to the city. The state of public transport can be considered as a quantifiable pricing factor, but it should be borne in mind that Koltsovo can not be reached by metro, tram, trolleybus, and the railway station is located 1 km from the science town. We should note that Koltsovo is a typical product of Soviet urbanization, which assumed the subordination of urban infrastructure to industrial rather than social tasks [21].

The Koltsovo science town is far from the center of Novosibirsk at a sufficient distance to be considered an ecologically safe area, but the Berezovoy quarters are located close to Koltsovo, so, they can borrow an “ecologically clean” image. The ecological characteristics of the territory are for a modern city dweller a comprehensive indicator of prosperity [22], especially for residents of the polluted industrial cities of Siberia.

The second pair of residential quarters of the Ob HPS microdistricts - "Gateway" is united by access to the infrastructure of summer recreation. Novosibirsk has never had the image of a resort city, despite its proximity to an artificial reservoir - the Ob reservoir. Continental climate with a predominantly cold air temperature makes it practically suitable for a beach holiday only two summer months: July and August. We should also note that studies of the housing market on the US ocean coast show the insignificance of such a factor as the proximity of housing to the beach area, taking into account the fact that we are talking about the ocean with its colossal recreational effect [23], at least in comparison with the artificial Ob reservoir.

As a typical urban suburb, both "Gateway" and the Ob HPS are located not far from garden partnerships and farms cooperatives. Rest in the country is a surrogate option for outdoor recreation, widespread in the USSR, and now in Russia. Russian citizen classifies the time spent at the farms as well spent, regardless of the actual recreational and environmental characteristics of farms territories. Labor on the farm land is perceived by a city dweller as a rest, changing an activity, because some of the modern townspeople have peasant roots [24], even if they have not inherited the instrumental peasant habits and skills.

At the same time, both of these microdistricts are located near a giant energy facility - the Novosibirsk Hydro-power plant. In fact, the areas are separated by the river Ob and the dam of the Novosibirsk Hydro-power station. The neighborhoods are simultaneously adjacent to important engineering facilities (energy, shipping, etc.) and to organized beach areas. In addition, both urban areas are well developed in terms of transport, social infrastructure, business and public services. As
districts, both territories in a pair are removed from the cultural and educational objects of Novosibirsk, which makes them related.

We have to consider the selection principle of residential real estate objects for this study.

The traditional residential development of Novosibirsk and the Soviet period agglomeration can not be called an aesthetic triumph. The USSR architects implemented the ideas of "democracy" and "equality", as well as consistency and complexity [25], but the monotony and monotony of the urban landscape became an obvious side effect, and the cities of Siberia were no exception ones.

The present study is dedicated to finding evidence of unequivocal hedonic markups on residential property. Secondary housing of the Soviet period is hardly the best object for such a study. Such housing is put on the market at obviously reasonable prices; in such a case, the hedonic mark-up must be demonstrable and obvious to the purchaser, having lost its marketable appearance over time. If an apartment, house, quarter, microdistrict has a minimum of its own (internal) advantages, there are very few factors that form the price difference.

In order to minimize the influence of entire complexes’ factors that determined the price of a residential property, it was decided to limit even such a characteristic as the number of storeys in an apartment building. The Ob HPS - "Gateway" pair includes only nine-storey buildings, which are quite typical for the most Russian cities. Unfortunately, the objects of study are not so homogeneous - there are apartments in five-, nine- and ten-story buildings (otherwise the sales statistics are too small) in the Beryozovoe - Koltsovo pair. Nevertheless, it should be assumed that the number of old Soviet-built residential buildings’ storeys in the Koltsovo science town and the Berezovoye microdistrict does not play a significant role, taking into account the age of the buildings and the degree of the adjacent territory development.

It is necessary to explain the choice for the study of a typical two-room apartment in the Soviet building period. A one-room apartment can serve as an object of rent extraction if it is acquired not for the purpose of living, but for renting; it is a popular way to generate "passive income" in Russia. A three-room apartment is a more expensive residential property, and although it is more intended for personal use than for rent, it may have more complex combined requirements; a four-room apartment and large apartments are generally exotic for an average Russian city. Thus, a two-room apartment of all the above is the most affordable and widespread housing for a small family, in which case, most often, environmental and recreational factors are not given due importance. Earlier, other researchers attempted to assess the housing situation of the post-Soviet Russia population, including living in such apartments, but no significant results were obtained [26].

For the purposes of our research, the actual data on the apartments for sale are presented in tables 3 and 4.

**Table 3.** List of 2-room apartments for sale in Koltsovo science town and Berezovoye microdistrict, dated March 12, 2020.

| №  | «Berezovoye» |  |  | Koltsovo |  |  |
|----|--------------|---|---|----------|---|---|
|    | Price, euro  | Square, m² | Price m², euro | Price, euro  | Square, m² | Price m², euro |
| 1  | 24 068       | 44  | 547  | 40 607  | 48  | 846  |
| 2  | 30 239       | 43  | 703  | 40 113  | 51  | 787  |
| 3  | 39 622       | 46  | 644  | 39 373  | 47  | 838  |
| 4  | 29 622       | 43  | 689  | 41 594  | 50  | 832  |
| 5  | 34 929       | 45  | 776  | 37 645  | 47  | 801  |
| 6  | 27 771       | 43  | 646  | 43 816  | 54  | 811  |
| 7  | 32 708       | 44  | 743  | 41 965  | 48  | 874  |
| 8  | 29 622       | 42  | 705  | 28 388  | 47  | 604  |
| 9  | 35 300       | 47  | 751  | 28 264  | 47  | 601  |
| 10 | 35 300       | 47  | 751  | 28 264  | 47  | 601  |
| 11 | 32 091       | 42  | 764  | ¬       | ¬  | ¬    |
| 12 | 25 919       | 44  | 589  | ¬       | ¬  | ¬    |
| 13 | 32 091       | 44  | 729  | ¬       | ¬  | ¬    |
| 14 | 32 708       | 43  | 761  | ¬       | ¬  | ¬    |
| 15 | 29 610       | 44  | 673  | ¬       | ¬  | ¬    |
Table 4. List of 2-room apartments for sale in the Ob HPS microdistricts and "Gateway" dated March 12, 2020.

| №  | the Ob HPS Price, euro | Square, m² | Price m², euro | «Gateway» Price, euro | Square, m² | Price m², euro |
|----|----------------------|------------|---------------|----------------------|------------|---------------|
| 1  | 33 325               | 44         | 757           | 36 410               | 53         | 687           |
| 2  | 34 164               | 52         | 657           | 35 781               | 54         | 663           |
| 3  | 35 176               | 53         | 664           | 35 793               | 54         | 663           |
| 4  | 27 277               | 43         | 634           | 37 028               | 54         | 686           |
| 5  | 27 154               | 44         | 617           | 35 176               | 54         | 651           |
| 6  | 32 955               | 43         | 766           | 32 091               | 43         | 746           |
| 7  | 31 967               | 45         | 710           | 40 113               | 53         | 757           |
| 8  | 35 114               | 50         | 702           | 41 224               | 53         | 778           |
| 9  | 36 904               | 52         | 710           | 39 249               | 54         | 727           |
| 10 | 32 708               | 54         | 606           | 44 433               | 52         | 854           |
| 11 | 32 461               | 54         | 601           | 43 816               | 52         | 843           |
| 12 | 29 622               | 47         | 630           | 42 829               | 53         | 808           |
| 13 | 33 325               | 44         | 757           | 41 347               | 43         | 962           |
| 14 | 32 091               | 46         | 698           | 39 496               | 43         | 919           |
| 15 | —                    | —          | —             | 32 708               | 48         | 681           |
| 16 | —                    | —          | —             | 34 559               | 54         | 640           |
| 17 | —                    | —          | —             | 38 262               | 51         | 750           |

It should be recalled that the study is designed in such a way as to neutralize the action of the most pricing factors, acknowledging some of the unrealized possibilities of the hedonic regression method. Accordingly, a full-fledged mathematical model (regression) for the purposes of this work is probably not mandatory, however, it is provided for in further studies.

Meanwhile, we may controversy spark a focus on a frankly outdated housing stock, as any hedonic advantages. Isn't it easier to turn to new buildings in the prestigious districts of the city and suburbs? Indeed, the latest projects, innovative technologies and materials, overall characteristics of living space, the latest infrastructure of microdistrict and adjacent territory - in the end, any of the listed items is a literal illustration of the very term "hedonism".

Such objections of opponents can lead to an insurmountable problem: the number of factors, taken into accounts the forming prices; the values of these factors confront the researcher with a mass of original, difficult to classify options. Let us dwell on one of the most important obstacles: investment behavior of participants in the new buildings market.

We have already mentioned the possibility of acquiring housing not for the purpose of living, but for the rent purpose. The researcher should not be confused by such a scenario, if an apartment has more pronounced ecological or recreational characteristics, then its rental price should be correspondingly higher than comparable, but incomplete analogues. For the buyer, this is still an understandable decision: purchase of a more expensive asset in order to extract a higher rent, so, the hedonic margin still exists, and it has a numerical expression.

Therefore, let us turn to another aspect of real estate investment so popular in modern Russia. In fact, the residential real estate market in the Russian Federation is the seller's market. New buildings are becoming objects of profitable monetary investments, since their prices will skyrocket as soon as a residential building is put into operation, and the finished apartments. The prices of apartments in new buildings may shock the difference with the prices of surrounding houses, but whether the hedonic regression method is applicable in this case to identifying the mark-up is a big question. Perhaps hedonic pricing in the market for new buildings in the city of Novosibirsk and its agglomeration may sooner or later become an object of study, but for the purposes of this work, typical, worn out, boring housing stock built in the Soviet period is the most suitable.

5. Conclusions
The hedonic method of pricing real estate has its merits, including the ability to value, based on a choice of advantage, accessible databases, while the method is easily adaptable to the relationship between other market goods and external factors. On the other hand, hedonic pricing also has
significant drawbacks, for example, it takes into account the willingness of buyers to pay higher prices for housing located next to a forest, but it does not take into account, that in the spring the basements in these houses are heated (and often the buyer is not aware), and all summer they have a musty, damp smell, but this does not reduce the overall price of housing. Hedonic pricing also does not always include external factors that can ultimately reduce the life quality.

The hedonic mark-up, obtained as the research result in a simple way needs further confirmation. It is planned to continue monitoring the prices dynamics for the specified type of real estate in the designated neighborhoods of the city. Mathematical model should be obtained, probably confirming the above conclusions, but on the basis of a larger amount of data, based on the results of observations in dynamics.

In addition, the behavior of an outdated secondary real estate buyer is assessed so far without taking into account the opinion of the buyer himself. It is necessary to establish feedback with the buyers of such apartments for the accuracy of the result, perhaps using a questionnaire or survey, to ensure the importance of the hedonic markup attributes. In modern Russia, this seems to be an extremely difficult task, since Russians are reluctant to discuss expensive purchases, and no doubt, housing is the most significant acquisition for most Russian families.

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