KAUNAS UNIVERSITY OF TECHNOLOGY

TOMAS SKRIPKIŪNAS

# THE INFLUENCE OF ARCHITECTURAL FACTORS ON THE HOUSING MARKET VALUE

Doctoral dissertation
Social Sciences, Economics (S 004)

2023, Kaunas

This doctoral dissertation was prepared at Kaunas University of Technology, School of Economics and Business, Academic Centre of Economics, Business and Management during the period of 2019–2023. The studies were supported by the Research Council of Lithuania.
The doctoral right has been granted to Kaunas University of Technology together with Klaipėda University and Lithuanian Energy Institute.

**Scientific Supervisor:**
Prof. Dr. Valentinas NAVICKAS (Kaunas University of Technology, Social Sciences, Economics, S 004).

Edited by: English language editor Brigita Brasienė (Publishing House *Technologija*), Lithuanian language editor Aurelija Gražina Rukšaitė (Publishing House *Technologija*)



The public defense of the dissertation will be held at 10 a.m. on 19 October, 2023 at the public meeting of Dissertation Defense Board of Economics Science Field in Rectorate Hall at Kaunas University of Technology.

Address: K. Donelaičio 73-402, Kaunas, LT-44249, Lithuania
Phone: (+370) 608 28 527; e-mail doktorantura@ktu.lt

The doctoral dissertation was sent out on 19 September, 2023.
The doctoral dissertation is available on the internet http://ktu.edu and at the libraries of Kaunas University of Technology (Gedimino 50, Kaunas, LT-44239, Lithuania), Klaipėda University (H. Manto 84, Klaipėda, LT-92294, Lithuania) and Lithuanian Energy Institute (Breslaujos 3, Kaunas, LT-44403, Lithuania).

KAUNO TECHNOLOGIJOS UNIVERSITETAS

TOMAS SKRIPKIŪNAS

# ARCHITEKTŪRINIŲ VEIKSNIŲ ĮTAKA BŪSTO RINKOS VERTEI

Daktaro disertacija
Socialiniai mokslai, ekonomika (S 004)

2023, Kaunas

Disertacija rengta 2019 – 2023 metais Kauno technologijos universiteto Ekonomikos ir verslo fakultete, Ekonomikos, verslo ir vadybos akademiniame centre. Mokslinius tyrimus rėmė Lietuvos mokslo taryba.
Doktorantūros teisė Kauno technologijos universitetui suteikta kartu su Klaipėdos universitetu ir Lietuvos energetikos institutu.

**Mokslinis vadovas:**
prof. dr. Valentinas NAVICKAS (Kauno technologijos universitetas, socialiniai mokslai, ekonomika, S 004).

Redagavo: anglų kalbos redaktorė Brigita Brasienė (leidykla „Technologija“), lietuvių kalbos redaktorė Aurelija Gražina Rukšaitė (leidykla „Technologija“)



Disertacija bus ginama viešame Ekonomikos mokslo krypties disertacijos gynimo tarybos posėdyje 2023 m. spalio 19 d. 10 val. Kauno technologijos universiteto Rektorato salėje.

Adresas: K. Donelaičio g. 73-402, Kaunas, LT-44249, Lietuva
Tel. (+370) 608 28 527; el. paštas doktorantura@ktu.lt

Disertacija išsiųsta 2023 m. rugsėjo 19 d.
Su disertacija galima susipažinti interneto svetainėje http://ktu.edu ir Kauno technologijos universiteto bibliotekoje (Gedimino g. 50, Kaunas, LT-44239, Lietuva), Klaipėdos universiteto bibliotekoje (H. Manto g. 84, Klaipėda, LT-92294, Lietuva) ir Lietuvos energetikos instituto bibliotekoje (Breslaujos g. 3, Kaunas, LT-44403, Lietuva).

**TABLE OF CONTENTS**


LIST OF FIGURES 7
LIST OF TABLES 9
INTRODUCTION 10
1. THE THEORETICAL BACKGROUND OF RESEARCH ON THE ARCHITECTURAL FACTORS AND HOUSING MARKET VALUE 18
1.1. Background: the fundamentals and unexplained volatility over the time of the housing market value 18
1.1.1. The uniqueness of the housing market 18
1.1.2. The fundamentals of the housing market value 18
1.1.3. The unexplained or irrational factors of the housing market value 21
1.2. Foreground: the variance across space and spatial bubbles of the housing market value 24
1.2.1. The spatial dependency of the housing market value 24
1.2.2. The identification of spatial bubbles in the housing market 26
1.2.3. The multiple dimensions of the housing market value 29
1.3. The outlines of architectural factors 30
1.3.1. The architectural aspects of the real estate economics 30
1.3.2. The interrelationship between architecture and built environment 33
1.3.3. The concept of the housing market value 36
1.3.4. The concept of architectural factors 41
1.3.5. The classification of architectural factors 52
1.3.6. The positioning of architecture between market value and public value 56
2. THE MODEL AND METHODOLOGY OF EMPIRICAL RESEARCH ABOUT THE INFLUENCE OF ARCHITECTURAL FACTORS ON THE HOUSING MARKET VALUE 60
2.1. The theoretical model of the influence of architectural factors on the housing market value 60
2.2. The strategy of empirical research 63
2.3. The design of empirical research 64
2.4. The empirical model of the influence of architectural factors on the housing market value 66
2.5. The selected data and research methods 67
3. THE RESULTS OF EMPIRICAL RESEARCH ON THE INFLUENCE OF ARCHITECTURAL FACTORS ON THE HOUSING MARKET VALUE 72
3.1. Controlling for non-design architectural factors 72
3.1.1. The single variable regression of non-design factors 72
3.1.2. The multivariate regression of non-design factors 75

3.2. Measuring the influence of design factors on the housing market value 79
3.2.1. The correlation between market value and urban and planning design factors 79
3.2.2. The multivariate regression of urban and planning design factors 80
3.3. The final results and discussion 82
CONCLUSIONS 86
SUMMARY 89
REFERENCES 108
LIST OF PUBLICATIONS 118
CURRICULUM VITAE 120

## LIST OF FIGURES

**Figure 1**. Blocks of determinants of the housing market value; source: data from Glindro et al. (2011), figure created by the author 19
**Figure 2**. The housing estate market equilibrium, upper and lower market bubbles; source: Pilinkienė et al. (2020), figure modified by the author 27
**Figure 3**. The hidden variance across space in Ober-Haus Lithuanian apartment price index (OBHI) (1994 = 100); source: Ober-Haus (2020), figure modified by the author 28
**Figure 4**. Multiple dimensions of the housing market value; source: created by the author 29
**Figure 5**. The interrelationship between architecture and built environment; source: created by the author 34
**Figure 6**. Structural, location and neighbourhood factors; source: created by the author 40
**Figure 7**. Layers of the housing market value; source: created by the author 40
**Figure 8**. The structural hierarchy of architectural factors; source: created by the author 53
**Figure 9**. Dimensions and categories of architectural factors; source: created by the author 54
**Figure 10**. The classification of architectural factors; source: created by the author 55
**Figure 11**. The position of buildings between market and public; source: created by the author 58
**Figure 12**. The theoretical framework of transfers of private and public value between the built environment and housing market value; source: created by the author 61
**Figure 13**. The theoretical model of the influence of architectural factors on the housing market value; source: created by the author 62
**Figure 14**. The design of empirical research; source: created by the author 65
**Figure 15**. The empirical model of the influence of architectural factors on the housing market value; source: created by the author 67
**Figure 16**. Images of urban and planning design factors: (1) intensity, (2) density, (3) height_max and (4) commerce; source: Masterplan of Vilnius (2021), figure modified by the author 70
**Figure 17**. Histogram of the selected data (NT žemėlapis, 2021); source: created by the author 71
**Figure 18**. The influence of floor number on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author 73
**Figure 19**. The influence of apartment size on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author 73

**Figure 20**. The influence of distance to the city centre on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author 73
**Figure 21**. The influence of distance to the city centre on the price per sq. m of the selected apartments in Vilnius, dataset No. 2 (ntzemelapis.lt); source: created by the author 74
**Figure 22**. The influence of distance to the civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author 74
**Figure 23**. The influence of distance to the civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 2 (ntzemelapis.lt); source: created by the author 74
**Figure 24**. The influence of number of civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author 75
**Figure 25**. The influence of number of civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 2 (ntzemelapis.lt); source: created by the author 75
**Figure 26**. The map of Vilnius; source: maps.lt (2021), figure modified by the author 78
**Figure 27**. The statistical surface diagram of unexplained residual variance of apartment market value in Vilnius; source: created by the author 78
**Figure 28**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – intensity; source: created by the author 79
**Figure 29**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – height; source: created by the author 79
**Figure 30**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – density; source: created by the author 80
**Figure 31**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – commerce; source: created by the author 80
**Figure 32**. The decomposition of influence of architectural factors on the housing market value; source: created by the author 83

## LIST OF TABLES

**Table 1**. Public policy dimensions; source: Carmona (2019) 37
**Table 2**. Determinants of the housing market value; source: created by the author 44
**Table 3**. Value that the built environment generates; source: Carmona (2019), table modified by the author 48
**Table 4**. Descriptive statistics of the selected dataset No. 1 (developers); source: created by the author 69
**Table 5**. Descriptive statistics of the selected dataset No. 2 (ntzemelapis.lt); source: created by the author 69
**Table 6**. The influence of non-design control factors on the price per sq. m multivariate regression results; source: created by the author 76
**Table 7**. The comparison of coefficients of two branches of the first stage; source: created by the author 77
**Table 8**. The influence of design factors on the price per sq. m multivariate regression results; source: created by the author 81

# INTRODUCTION

## The relevance of the research topic

The research on the built environment is rather fragmented between the architectural professionals, economists, geographers and others. However, in the context of social, cultural, economic and environmental values, built environment occupies the core position. Architecture, as art and science that shape the built environment, becomes rather influential in that sense. A hypothesis is raised that the architectural factors can have their role on fixing the housing market value.

Nowadays, housing alone, as a major part of the built environment, can be seen parallel with the corporate stocks, commodities or other speculative assets. Although real estate, in general, is the second biggest asset class worldwide, the housing market may be larger than the value of the entire stock market in some countries, especially in the Baltic States. In the Baltic States, the amount of outstanding housing loans to households was EUR 19.0 billion in 2018 (Hypostat, 2019), and the market capitalization of listed companies was EUR 6.7 billion (Nasdaq, 2020). This suggests that the housing market takes a huge amount of the assets either as consumer or investment good.

The volatility over the time and the variance across space of the housing market value are discussed in order to establish the theoretical framework to understand the background of the housing macro dynamics and the position of architecture in the housing market value volatility and variance. The micro determinants of housing market value are usually observed at a fixed time or during short-term period, trying to introduce the best factors that determine the market value. Adding temporal effects for longer periods of time introduces even more complications. Although various models of the housing market volatility and variance have been developed, the fundamental question of what drives the housing market value is still peculiarly neglected.

There is a lot of unexplained volatility and variance in the housing market value. Learning from the behavioural finance, much of that volatility and variance can be attributed to the unexplained or irrational factors. A critical emphasis may be developed on the explained, rational, monetary (market) or non-design dimensions of the real estate valuation, which omits the unexplained irrational, non-market or design properties of the real estate.

The concept of architecture and architectural factors are not commonly used in the economics. They have controversial meaning in literature; therefore, a broader definition of architecture is suggested, which includes the design of the total built environment from the macro level of urban and planning to the micro level of buildings. Moreover, architecture and built environment have different meanings in this research: built environment refers to the physical objects of architecture (buildings as well as streets, bridges, sidewalks, landscape structures and small scale objects) while architecture is used to express the design of those objects.

Many research studies acknowledge the influence of architectural factors on the housing market value, but there is no clear answer to the scale of that influence. There are studies on hedonic regression models trying to integrate the architectural factors

to predict the housing market value better. These include studies on the spatial dependency, architectural and urban design factors or style and their impact on the housing market value. While most research studies are focusing on the volatility over time and adding architectural factors as control variables to address the heterogeneity of buildings, there is no systemic overview and theoretical framework of the influence of architectural factors alone, including the transfers of value between the built environment, its non-market or public properties and the housing market value. The scope of this research is to fill the research gaps between the research on the housing market value volatility over time, variance across space (different cycles in different locations) and research on the determinants of housing market value. The main contribution will be provided to the field of the housing market value variance across space.

All in all, the influence of architectural factors, in the widest sense, on the real estate economics is neglected. The core idea of this research is to investigate the value of architecture and how it is transferred to the market value of a property, therefore resulting in higher added value of newly constructed buildings or higher capital values of the existing buildings. If this way is considered, the architectural factors are looked at as an integral part of the real estate economics, and the economists could get another tool for the analysis, valuation and prediction, while architecture professionals can benefit from the latest achievements that the economics can offer.

**The research question**

How are the architectural factors influencing the spatial dependency of the housing market value?

**The research object**

The architectural factors of the housing market value.

**The research aim**

To evaluate the influence of architectural factors on the housing market value.

**The research objectives**

1. To identify the dimensions of a housing market value volatility over time and variance across space and identify the spatial bubbles.
2. To determine the concept of architectural factors in the context of real estate economics and classify those architectural factors.
3. To develop the theoretical framework of the influence of architectural factors on the housing market.
4. To develop and verify the model and methodology for evaluating the influence of architectural factors on the housing market value.

## The level of investigation of the research question[1]

The use of architectural factors in the literature is moderate. Five major areas where architectural factors are used in research could be identified: (1) spatial dependency, (2) urban and building design quality factors, (3) heritage aspects, (4) sustainability aspects, (5) public value of architecture. The selected research studies demonstrate the significance of those factors.

(1) *Spatial dependency, spillovers of value, externalities*. The problems of spatial effects have been ignored in the real estate analysis to an extent. However, the real estate data is highly spatially dependent. In recent decades, spatial econometrics was used to incorporate neighbourhood dynamics and spillovers of house prices into the traditional hedonic model (Anselin, 1988; Can, 1990; Le Sage, 1998; Le Sage and Pace 2009; Wilhelmsson, 2002, 2004). Other spatial econometric approaches, such as the distance to urban focal points in the city, have been tested (Gat, 1998; Gong et al., 2016). There has been conducted a research on how to incorporate those spatial econometric models better in recent studies, comparing different spatial econometric methods (Stamou et al., 2017). The research has shown that the houses designed by Frank Lloyd Wright (a famous American architect) have a positive effect on the prices of houses nearby (Ahlfeldt and Mastro, 2012). A price impact of attractive neighbouring buildings was captured with a computer vision technique as well (Glaeser et al., 2018). These interventions suggest that the buildings in urban environments are affected by the appearance of the surroundings.

(2) *Urban and building design quality factors*. Many studies have attempted to add the qualitative factors or expert ratings to the hedonic regression models. One of the earliest studies by Hough and Kratz (1983) assessed the influence of architectural factors on the office rent prices in downtown Chicago. New commercial buildings that won the architectural awards had a 22% rent premium. Vandell and Lane (1989) found that the better is the design quality of office buildings, the higher is the rent. They surveyed architects and used disaggregation analysis to measure the quality of architecture. This was followed by Asabere et al. (1989) finding a price premium for certain architectural styles. Fuerst et al. (2011) proved that the offices that were designed by famous architects had higher rent levels. Different aspects of design quality in the apartment units in the Belfast City Centre were evaluated by applying and extending the hedonic model to include building and urban level quality factors (Nase et al., 2016). The research was performed by measuring the price effect of the neo-traditional architectural style of buildings (Buitelaar and Schilder, 2017). All these studies mostly found a positive relation between good design and the real estate market value.

(3) *Heritage aspects*. Architecture is perceived by people through their mind and memory; therefore, the collective memory gives a meaning to places, altering the

[1] This sub-section has been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., Tanas, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: A methodological framework. *Journal of international studies, 13*(4), 38–53. doi:10.14254/2071-8330.2020/13-4/3

valuation of the real estate. A price premium was found in the cases that involved the listed buildings, the neighbouring buildings to listed buildings and cultural historic site areas (Lazrak et al., 2014). The same was observed in the historic districts in New York (Been et al., 2014). In a recent study by Rudokas et al. (2019), landmark buildings were more expensive to maintain, therefore, resulting in lower rent prices. However, they acted as positive externalities for neighbouring buildings. The influence of the heritage aspects of architecture to the real estate market value were found in most cases, in particular when considering new buildings adjacent to the listed buildings and historic site areas.

(4) *Sustainability aspects*. The need to evaluate the effect of architectural factors on the value of sustainable houses is addressed. Architectural design integrates a great variety of decisions in a building project, including orientation, window placements, space configuration, and the choice of finishing materials (Fadaei, 2015). Good design can attract clients to sustainable houses, therefore, resulting in price premiums for investors of sustainable houses. People know that they can save 25% on energy bills by buying a correctly solar orientated house (Rashkin, 2010). Urban form has an impact on the energy consumption (Ewing and Rong, 2008; Ratti et al., 2005; Chen et al., 2011; Lee and Lee, 2014), mobility and services in the city (Zhou et al., 2013; Nakamura and Hayashi, 2013). Urban design and landscape design have an impact on the microclimate (Bowler et al., 2010; Ko and Radke, 2014; Jamei et al., 2016), air pollution and noise (Honold et al., 2012). Generally, a great deal of architectural solutions can contribute to the achieve sustainability goals in the real estate economics.

(5) *Public value of architecture. Architecture as non-market or public good*. Referring to architecture as a public good in a city, the value to its inhabitants and tourism may be captured. Scerri et al. (2019) noticed that special local characteristics of place are captured and enhanced by the architectural factors, and the tourists are attracted to consume its unique design qualities. This makes architecture an externality or public good that contributes significantly to the economic activity. The pattern of consumption is highly influenced by the positioning of architecture landmarks, public space, and urban design structure (Aranburu et al., 2016). There is an implicit market for the environmental goods in the city. The environmental quality can influence where to live, work, and relax (Champ et al., 2017). Regarding the architectural factors, it does not explicitly purchase architectural quality, or widely speaking, architecture. The real estate market links to the non-market goods make it possible to infer values for the demand of architecture as a non-market good revealed through the housing purchases.

*Other built environment outcomes*. The value that the built environment generates was revealed by systematic study by Carmona (2019). It was backed up by 271 research studies that were included in the review focusing on the added value of quality of space. The full range of the public policy dimensions covered by Carmona (2019) are (1) health, (2) society, (3) economy and (4) environment.

Generally, it can be stated that the level of research on the scientific problem is moderate. The architectural factors are used in the econometric models addressing the issues of spatial dependency; however, these factors are most likely control variables

rather than the object of the research. The research on architectural factors is fragmented and lacks the overall picture.

**The research novelty and practical significance**

(1) *The identification of unexplained factors of a housing market value coming from other fields of science and art – architecture. The identification of spatial bubbles in a housing market at a city scale*. The theory of bubble formation is used to explain the spatial dependency in the housing market value data rather than the volatility over time. The hypothesis is raised that the architectural factors can have an influence on the housing market value variance across space. This leads to the identification of spatial bubbles across space in a housing market at a fixed moment in time. The well-known economic concepts of real estate cycles and bubbles are applied in a non-traditional way in this research.

*The practical significance*. The position of architecture, in its widest sense, between art, science and economics and the position of architectural factors in economic literature, agenda and discourse are identified. The awareness of value transfers between the built environment and the housing market value creates the theoretical foundation of these concepts for the practical implementation. This study adds another dimension, i.e., the unexplained variance across space, to the housing market value research. Architecture is introduced as an irrational factor that can explain spatial bubbles.

(2) *The specification of the concept of architectural factors in a housing market and the classification of those factors*. The position of architectural factors in the economic literature, agenda and discourse is identified. Two dimensions that are splitting those factors into four categories are defined. Architecture may have different meanings; therefore, some alignment is needed in the context of economics. While many may think of architecture as a style of a building, this research tries to introduce the understanding that architecture covers non-design and design properties at urban and planning level as well as building level.

*The practical significance*. Although some of the architectural factors are already used, more architectural factors, especially design factors, could be used to improve the hedonic housing market value models. The differences between various variables, such as apartment size, style, building type, urban density and others, are identified when categorising architectural factors. The classification of those factors infers the possible areas of application.

(3) *The development of theoretical framework of the influence of architectural factors on the housing market value*. Scientific novelty of this research is an attempt to connect these two areas (architectural factors and market value) of research in one theoretical framework that may identify possible ways to improve the understanding of links between the architectural factors of the built environment and its market value. The research vector is aimed at the possible value for the real estate economics that may emerge from decisions that are made by the architects and their teams as well as the other way around.

*The practical significance*. The theoretical framework of the influence of architectural factors on the housing market value suggests the system of factors and

dimensions of what drives a housing market value. The framework represents different dimensions of a housing market value focusing on the variance across space at a fixed moment in time, indicating future research possibilities.

(4) *The model and methodology for evaluating the influence of architectural factors on the housing market value*. The architectural design factors are introduced as an unexplained or irrational factors to explain the residual variance across space at a fixed moment in time. Architecture, being the art and science of creating space, matches the idea of spatial bubbles inside a city. Different groups of architectural factors can distinguish the fundamental and unexplained parts of a housing market value.

*The practical significance*. The core components of a housing market value are defined. The model for evaluating the influence of architectural factors on the housing market value suggests possible improvements for the used asset valuation methods. Moreover, this model acts as the analysis of market and public values of architecture that are reflected in the market value of a property and may result in the policy suggestions for the investment between market and public goods inside a city.

**The research limitations and future possibilities**

The research topic consists of the architectural factors, housing and its market value. In the theoretical part, architecture and built environment are described in their widest sense, quickly narrowing down the scope to the housing and its market value variance across space to make the empirical research possible. In order to achieve this, the following limitations are applied:

(1) *The complexity of market value volatility over time is eliminated*. The data is collected at the fixed moment in time to eliminate the temporal effects. Although there is a theoretical background about the macroeconomic factors, the temporal effects are not in the scope of this study. The influence of architectural factors is to be looked at a fixed moment in time.

*The future possibilities*. It is possible that the changes in the macroeconomic factors can alter the significance of architectural factors over the time. Adding volatility over the time while looking at the changes in variance across space could be tested.

(2) *The absolute level of market value is not in the scope of this research, only the relative market value when comparing apartments one to each other is used.* As the complexity of the market value volatility over the time is eliminated, the absolute level of market value is not relevant and even becomes misleading over the time. Therefore, all the results are in relative values.

*The future possibilities*. If volatility over the time is added, the absolute level of market value would be another insight in the housing market value research.

(3) *The complexity of different functions of architecture is restricted to housing only, only the apartment market value is used for the empirical research*. As there is just one rather homogenous group of architectural objects, it may not reflect the full potential of the influence of architectural factors on the housing or real estate market value.

*The future possibilities*. Although it is very difficult to control for the heterogeneity of architectural objects, other types of architectural objects, for example, offices, could be tested.

(4) *The variables representing the design factors in the empirical research are restricted to urban design and planning factors*. Only urban design and planning factors are available to represent the design factors in the second stage of the empirical research. The building design factors stay in the residuals and can only be estimated to have such influence, but there is no prove of that.

*The future possibilities*. The building design factors, such as style, composition and others, could be tested. However, the challenge to collect such data exists. The qualitative research, e.g., expert survey, could be a starting point.

(5) *Although in the Lithuanian case it is common to buy an apartment with a piece of land that it is built on, the land prices are not considered in the context of this research*. It is assumed that the land is an inseparable part of the apartment building, and its value is embodied in the apartment market value as a result of urban and planning factors.

*The future possibilities*. The possible controls for land prices could be tested.

(6) *The masterplan of the city of Vilnius is used to extract the urban design and planning factors*. The masterplan captures the current situation with forward-looking perspective. Asset markets, in general, are looking forward, and the real estate market is naturally sensitive to the long-term perspective; thus, it makes sense that the housing estate market value is influenced by the forward-looking factors. However, it is important to note that the actual development and construction of what is in the masterplan is lagging.

*The future possibilities*. The urban design and planning factors could be collected manually; however, this would require an expert valuation. Other cities could be tested as well.

**The research methods**

This research utilizes the existing knowledge on the researched topic by introducing the systemic theoretical analysis, practical construction method and visualization of theoretical perspective. The interpretative-constructive methodological approach was chosen, which enabled to reveal the estimation of the researched phenomena and the structure of it. The empirical study is implemented by using correlation, single variable regression, interpolation and multivariate regression methods.

**The structure of the dissertation**

The relevance of the research topic, the research question, object, aim, objectives, the level of investigation of the research question, the research novelty and practical significance, the research limitations and future possibilities, and the research methods are presented in the introduction.

(1) The first part of this work contains the theoretical background that prepares a foundation for this scientific work and the hypotheses that could be raised from that theoretical background. The first part is further divided into four sections:

(1.1) *The fundamentals and unexplained volatility of a housing market value*. The irrational nature of the housing market is discussed in this section. The determinants of the housing market value can be described by rational and unexplained or irrational factors. While rational factors, largely consisting of the real estate market fundamentals, can explain the aggregated market value over longer periods of time, the irrational indicators should be added in order to explain the volatility of the market value over shorter periods of time or in particular areas.

(1.2) *The spatial bubbles of a housing market value*. The theory of bubble formation is shifted towards the spatial dimension to account for this unexplained variance across space that is left for unexplained or irrational factors. Unexplained variance across space is attributed to the architectural factors.

(1.3) *The architectural factors*. This part tries to systematize the existing research on the architectural factors in the real estate economics and the concept of value, either that built environment can generate or that is translated to the market value.

(1.4) *The theoretical framework of the influence of architectural factors on the housing market value*. The theoretical framework is to structure the influence of architectural factors on the housing market value and present a framework for the upcoming research.

(2) The second part presents the methodology and a model for the empirical research.

(3) The third part of this work contains the empirical research and discussion that arises from its main findings. The empirical research shows the influence of the architectural factors on the apartment market value.

Consolidated conclusions are presented at the end of this work, reflecting the aim and objectives of the scientific work.

# 1. THE THEORETICAL BACKGROUND OF RESEARCH ON THE ARCHITECTURAL FACTORS AND HOUSING MARKET VALUE

## 1.1. Background: the fundamentals and unexplained volatility over the time of the housing market value[2]

### 1.1.1. The uniqueness of the housing market

All consumer goods and services can have substitutes while competing for a place in the consumer's budget. However, some commodities are more related to each other and can be grouped according to their closeness. What counts as commodities in the housing market are various forms of shelter substitutes. Still, these units constitute a strongly separated cluster as compared to the transport or electronics. The concept of a housing market becomes meaningful because housing constitutes a commodity that is distinct from the other consumer goods (Blank and Winnick, 1953). It is an item that answers to one of the basic needs and cannot be simply dismissed in the family budget.

The housing market is as well a local market. A person would seek for a house or apartment within some distance from his/her work, school or other relevant locations; therefore, houses or apartments that are more distant are not even close substitutes. Furthermore, there are various submarkets in the housing market. Those could be identified by the size, quality, tenure type, structure type, neighbourhood, location and others. In addition to this, the housing market is personal and sensitive. The fact that economic actors buy a house one, two or three times during their lifetime makes those decisions risky because the gains and losses cannot be determined due to the frequent trading. Therefore, the policy makers should monitor the housing market value because in most societies, buying a house is a major financial risk that the households are facing (Cocco, 2004; Yao and Zhang, 2005).

Housing is an investment and consumption at the same time. The decision to purchase rather than rent is an investment opportunity and a personal preference of lifestyle (Shiller, 2007). Another important aspect of the housing market is that the transaction costs are high. Together with a small number of transactions, this results in slow response and operations (consider the inefficiency of the real estate markets) and makes the housing market long-term focused.

### 1.1.2. The fundamentals of the housing market value

*Macroeconomic factors*. There are studies that are trying to find the links between the major macroeconomic factors and the housing market value or its volatility. A study by Glindro et al. (2011) assumes that in each period, in each area

[2] This sub-section has been quoted verbatim from the following source: Navickas, V., & Skripkiūnas, T. (2020). Macro dynamics of the real estate market value: Temporal effects. *Torun international studies, 1*(13), 119–129. doi:10.12775/TIS.2020.009

(a country or a city), there is a fundamental value of housing that is largely determined by the economic conditions and institutional arrangements:

$$P^*_{it} = f(X_{it});$$

where $P^*_{it}$ is the log of the real fundamental value of the house prices in the country $i$ at time $t$, $f(\cdot)$ is a function and $X_{it}$ is a vector of macroeconomic and institutional variables that determines the house price fundamentals. Glindro et al. (2011) suggest four blocks of explanatory variables based on the theoretic reasoning or previous empirical work (Figure 1). The first block of explanatory variables are demand-side factors, including real GDP, population, the real mortgage rate and the mortgage credit to GDP ratio. It is assumed that higher income, higher population and higher financial capacity tend to encourage greater demand for new housing. The second block of variables are supply-side factors, including land supply index and real construction cost. Higher flexibility of the land supply tends to drive housing market value down, while the relationship between the real construction costs and housing market value is expected to be positive. The third block of variables are prices of other types of assets, including equity prices and exchange rates. Housing market value is positively correlated with the equity prices (Sutton, 2002; Borio and McGuire, 2004). A real effective exchange rate appreciation is expected to have a positive effect on the housing market value, particularly on the markets, where there is a substantial demand from non-residents for the investment purposes. The fourth block of variables are institutional factors, including the business freedom index, the corruption index, the financial sector index and the property rights index. The institutional factor measures the impact of business, regulatory and financial conditions.

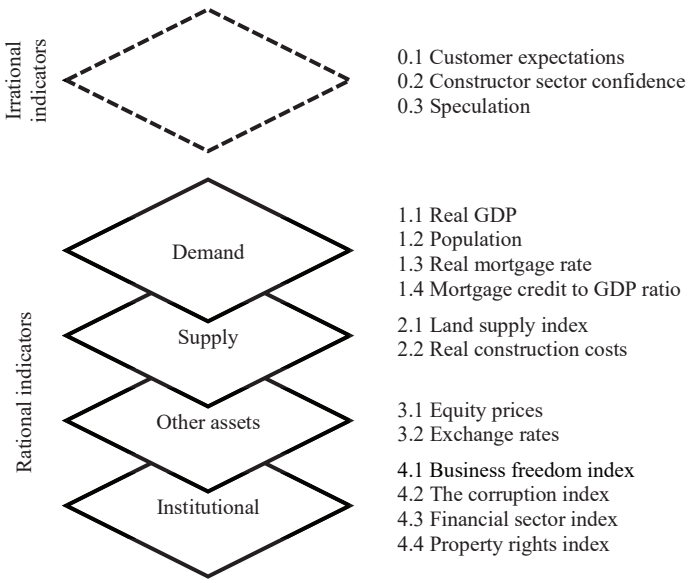



**Figure 1**. Blocks of determinants of the housing market value; source: data from Glindro et al. (2011), figure created by the author

Agnello and Schuknecht (2009) as well use a set of variables reflecting the economic fundamentals (growth in per-capita real GDP, level of short-term interest rates, growth rate of the real credit to the private sector and growth rate of global-liquidity variable), adding demographic and institutional variables in order to explain the business cycles in the housing market. Jadevicius (2016) examines the macro-determinants of the Lithuanian housing market values, documenting a relationship between the housing price growth and building activity, interest rates, inflation and employment. Capozza et al. (2002) are looking for a model that treats the housing market value as a function of city size, growth rate of population, growth rate of the real income and real construction costs.

*Social, cultural and political background*. In addition to the major macroeconomic background, social, cultural and political factors play an important role. Drachal (2014) studies the relations between the property prices and local labour markets in Poland. Polish regions (voivodeships) are characterized by highly differential unemployment rates, average wages, property prices. High unemployment is seen as an indicator of unstable future earnings. It was conclusively demonstrated that new available housing space, unemployment rate, construction costs and wages are significant in the regression models. However, the results differ across voivodeships because of the above-stated discrepancies. The implications for future research suggest to test for the time needed to find a job, the time spent on travelling to work, access to medical centres, training centres, schools and universities, a number of theatres, cinemas, community centres, and other factors connected with the standard of living and the changes therein in the selected cities. This is the case of Polish social, cultural and political environment, while other countries might have different scenarios.

Grum and Govekar (2016) study whether the selected macroeconomic variables (the unemployment rate, the current account of the country stock index, GDP and industrial production) have influence on the housing market value in different cultural environments (Slovenia, Greece, France, Poland and Norway). The results show a distinction between Slovenia, in which the relationship between the housing market value and stock index was found to be statistically significant, and other countries, in which the relationship was not found to be statistically significant. The correlation between the housing market value and unemployment was found in the other countries instead. Further research is needed to understand this distinction between different social, cultural and political environments.

Egert and Mihaljek (2007) address the question whether the conventional fundamental determinants of house prices, such as GDP per capita, real interest rates, housing credit and demographic factors, have driven observed house prices in the period from around 1990 to 2005 in the central and eastern European (CEE) countries and 19 developed OECD countries. The research results suggest that GDP per capita, real interest rate, ratio of housing credit to GDP, population, labour force, unemployment and equity prices are statistically significant in the way economic logic suggests. In addition to this, the transition-specific factors on the house price dynamics in the CEE were assessed. These include slow development of housing markets and weak housing finance institutions before 2000, limited supply of new

homes, lower measures of housing quality (average size of dwellings, floor space per occupant, access to piped water and fixed baths). Again, these factors were peculiar to social, cultural and political background of the CEE countries.

The mix of macroeconomic variables, social, political and cultural situation automatically bring about the unpredictability of the housing market. However, after assessing these fundamentals of the housing market value, other factors may be added, such as short-term dynamics and unexplained or irrational factors. The research conducted by Tupenaite et al. (2017) reveals that housing market value fluctuations in Lithuania within the period of 2005–2015 can be largely explained by the economic fundamentals and housing market indicators (empirical study was carried out using the Analytic Hierarchy Process (AHP) method). However, the determinants of housing market fluctuations are divided into irrational and rational indicators (Figure 1). Rational indicators (q = 0.8019) consist of economic indicators (including GDP, inflation, earnings per capita, unemployment rate, interest rates and housing mortgages, all together contributing to q = 0.4939 of decision criteria) and market indicators (including new housing supply, building permissions, construction price index, housing transactions and housing affordability, all together contributing to q = 0.3080 of decision criteria). Irrational indicators (q = 0.1981) consist of customer expectations, construction sector confidence and speculation (Tupenaite et al., 2017). The results suggest that 80 percent of the determinants are of rational character, and they stem from the belief in the efficiency of the housing market, leaving 20 percent to the irrationality of behavioural economics. This study reveals what drives the housing market value from the human perspective without resorting to econometric models. Therefore, the irrational nature of human behaviour may be underestimated, as the following sub-section suggests. It is possible that the expectations might built up, thus forming bubbles of professional and expert level.

### 1.1.3. The unexplained or irrational factors of the housing market value

*Speculative assets*. Nowadays, there is a belief in society that housing is an investment opportunity. However, the housing market in most cases was not supposed to be speculative until a few decades ago. The conventional belief was that the housing market value was driven by the construction costs (Grebler et al., 1956). Shiller (2007) agrees with this idea comparing a house with furniture, both of which are supposed to be consumed but not held as assets to make money (while talking about the 1950s and several decades after). This belief changed rapidly once entering the new millennium. In the United States, the real home market value increased by 86 percent between 1996 and 2006 according to S&P/Case-Shiller National Home Price Index (Shiller, 2007). This dramatic increase in price would be hard to explain in terms of the fundamentals of the housing market (see sub-section 1.1.2.) and macroeconomic factors. Shiller (2007) highlights that in the same period, the real rent increased only by 4 percent, therefore being extremely stable with the real construction costs showing relatively little change, which corresponds with the real rent but not with the housing market value. Moreover, housing versus consumption ratio was stable, fluctuating around 15 percent. The residential investment as a percent of GDP was volatile but did not show any long-term trend. Thus, the conclusion is made by Shiller (2007) that

some other important factors have an impact on the housing market value. An assumption can be made about the irrational nature of the housing market.

*The inefficiency of the housing market*. According to the efficient-market hypothesis, attributed to Fama (1970), a market in which the market value always fully reflects available information is called efficient. This rational nature of market value is based on the forecasts of earnings, assessments of risk factors for corporations or payouts of dividends for the stock market. Although various research was done to prove that the efficient-market hypothesis cannot account for reality, this can constitute a point of departure for pointing to the market inefficiencies. Comparing the housing market to the stock market, the housing market has much higher cost of trading to it. It is difficult for the professional traders to enter and exit the market or do short sales. Moreover, housing as an asset is characterized by a high cost of carry, low rental income and complicated administration. Furthermore, there are possible local factors that might affect the demand (Shiller, 2014). Therefore, the housing market is highly inefficient. In order to understand the factors of speculative markets, including the housing market inefficiency, Shiller (2014), once again, suggests studying other sciences outside of the economics.

*Irrational nature of the housing market*. An increase in the housing market value that is hard to explain can be called a bubble. A definition of a bubble is offered by Shiller (2005):

> A situation in which news of price increases spurs investor enthusiasm which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increase and bringing in a larger and larger class of investors, who, despite doubts about the real value of the investment, are drawn to it partly through envy of others' successes and partly through a gambler's excitement.

The epidemic nature, emotions as well as information media are core constituents in this definition. A speculative bubble is seen as social epidemic, a result of the principles of social psychology and media exposure. Sociology suggests theories about the collective consciousness (Durkheim, 1933), collective memory (Halbwachs and Coser, 1992), shared mindsets and beliefs. Shiller (2014) argues that these ideas may not be especially rational or efficient, but when amplified by the media, they give rise to some inefficient market behaviour. The important component is collectivity; therefore, "the market is micro efficient but macro inefficient" (Shiller, 2014). Therefore, similarly to stocks, aggregate housing value variations are driven by bubbles.

The idea that markets are substantially driven by cognitive biases is not new. For example, human tendency towards overconfidence causes investors to trade too much (Odean, 1999). The investors may be overly distracted by news stories (Barber and Odean, 2008) or overreact to cash dividends (Shefrin and Statman, 1984). Psychology and other social sciences got incorporated into the economics when behavioural economics attracted public attention in 1990s. Focusing on the irrationality of market fluctuations with the attention paid to the human economic

behaviour has resulted in some peculiar observations. Benos and Jochec (2013) showed that in the United States, the stocks with the words "America(n)" or "USA" in their names earned return of 6% a year during the wartime. Saunders (1993) found that the weather in New York affects the stock prices. These examples demonstrate the irrational nature of human behaviour. Similarly to the stock prices, the housing market is driven by the expectations. The expectation of growth based on the past results drove housing market value to their maximum in 2008. The steady recent growth strengthens the expectations about the future of the housing market value. Although considering the very long term, this is not always the case. Those expectations might be frustrated easily with some hints of the market drop, and the housing market is going back to its fundamentals.

*From sociology to architecture*. The discourse of modern architecture is highly appealing to the human expectations of standards of living or desires. There are some trends in society and the field of architecture that results in an increase of market value of some type of housing. Leinberger (2007) has shown that there is an increasing demand for "walkable urban centres" and proved that there is an increase in market value of properties in such urban centres. This increase reflects human expectations and desires for a city with lots of attractions within walking distance. Buitelaar and Schilder (2017) has shown that there is a price premium of neo-traditional style housing, although it is not completely clear whether that increase partly stems from a shortage of such properties in the short term, or from their type of quality for that matter. Considering the factors affecting stock prices, it may be the case that the housing market value is affected by the architectural factors.

Furthermore, the housing market bubbles are location-specific because some type of environment encourages the formation of bubbles that may bring economic benefit to some extent. Looking at the types of value that the construction sector generates (Carmona, 2019), districts, cities or regions can form some kind of "islands" of shared mindsets or beliefs with high expectations of speculative value. Then, the questions arise whether this formation of bubbles tend to be correlated with "good" architecture and whether it be possible that these expectations are driven by the desires that are created by the architects. If the bubbles are viewed spatially, the architectural factors should be searched for, logically speaking, because architecture defines the arrangement of the real estate objects in space. If the idea to look for an explanation of bubble formation in other sciences is considered seriously, the field of architecture is an option to look for, because it is an influential generator of image, desire and hence of value, similarly to the luxury or sports cars or other consumer desires to name a few. Furthermore, the irrational nature of human behaviour raises hypotheses that the real estate market value might be affected by the colour or other bizarre factors.

Efficient market theory has a similar concept as the housing fundamentals; however, looking at the fluctuations of the housing market value, the additional factors need to be found in order to determine it. The mix of the irrational nature of human behaviour and the efficient-market hypothesis automatically bring about the unpredictability of speculative asset markets with housing clearly becoming one of them. However, the unique characteristics of the housing market make it highly inefficient. Housing is an investment and a consumer good at the same time. When

considering it as an investment, it becomes a speculative asset, while being a commodity to be consumed, it is designed to be simply occupied instead of serving as a speculative asset.

Since economic actors are driven by the human needs and desires as well as making a profit, in the short term, the housing market is very different from the stock market because of a small number of transactions, making the former even more inefficient. The expectations of distant future are even more amplified. Although long-term expectations, driven by the consciousness of that time, might be suggested as an approximation, they could be far from the economic fundamentals in the short term. The irrationality of human behaviour suggests looking into other sciences with architecture being a tool serving to illuminate those irrationalities occurring in the housing market. Lots of questions remain unanswered; for example, whether architecture, coupled with the housing, is driven by the major macroeconomic factors, or whether architecture is a source of value, therefore driving the housing market. Given that the behavioural economics accounts for a significant part of the irrationality of the market behaviour, the hypothesis can be ventured that the architectural factors, as human interaction in the process, can have their own role in fixing the housing market value.

*Conclusions*. The housing market value includes fundamental/explained/rational/market part (architectural non-design factors) and unexplained/irrational/non-market part (architectural design factors).

### 1.2. Foreground: the variance across space and spatial bubbles of the housing market value

#### 1.2.1. The spatial dependency of the housing market value[3]

Long-term and mid-term volatility over time of the housing market value is the major concern of many research studies. However, there is less effort aimed to address the variance across space. Spatial trends are observed in the housing market value data. These trends across space are attributed to the quality of the built environment and, consequently, architectural factors in order to address the question how architectural factors are influencing the housing market value. From this point, the research focuses on the fixed moment in time, therefore, eliminating the complexities of temporal effects, such as macroeconomic factors. The concept of bubbles is taken from the irrational volatility over time; however, because architecture varies across space, the same concept is applied to the variance across space.

The housing market value spatial dependency has been addressed in literature in many aspects. Blank and Winnick (1953) have seen submarkets in the housing market of the United States. While submarkets can be based on various housing characteristics, neighbourhood is one of them. This has already started the discussion

[3] The 2nd, 3rd and 4th paragraphs of this sub-section have been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

of spatial differentiation in the housing market. Can (1990) has been looking at the neighbourhood dynamics of the housing market of Columbus, Ohio MSA, the United States, introducing neighbourhood, which is spatially dependent, into the housing price determination in the empirical research. The study from France by Roehner (1999) contains a model that can describe various price trajectories in 20 Paris districts while looking at the speculative trading, classic bubble formation argument and price-supply inelasticity in the selected districts. These studies have shown that the districts in the city can have significant differences while determining the housing market value, and this could be linked to the local supply and demand models. The research in this thesis employs a similar theoretical framework; however, the reasons behind the changes in supply and demand remain unclear. There has been hints of an unexplained or irrational nature of spatial differentiation as well.

The more recent study from China by Sun et al. (2017) looked at the spatial trends of the housing market bubbles in China regions and applied similar to the previously described model, but at the country scale. Although the scale and cultural context are different, the same mechanism can be introduced at the city scale. Zietz et al. (2008) have shown that the impact of various housing characteristics price may vary across the distribution of homes from Orem/Provo, Utah area, the United States. This suggests that the spatial differentiation could render traditional hedonic models inaccurate.

A study from the Netherlands by Buitelaar and Shilder (2017) considered the neo-traditional style as a determinant for demand, reason for the formation of submarkets and positive externality. As mentioned before, supply, demand, submarkets are the core determinants of the market value. However, demand is biased by the buyer's desire for a certain style, and, while real estate is fixed in place, the desire for a particular place at the same time. Glaeser (2017) has seen the benefits of the real estate bubbles as extra building or urban development. This raises a discussion of reverse causality in the context of this research, whether an urban development causes bubbles or bubbles encourage the urban development.

The existing research from broader economic context covering the long-term and mid-term volatility of assets market value, such as stock or housing market value, suggests that the market value can be deconstructed to its rational factors, i.e., fundamentals (Fama, 1970; Glindro et al., 2011), and unexplained or irrational factors, i.e., bubbles (Shiller, 2007; Shiller, 2014) (see sub-sections 1.1.2., 1.1.3.). This strategy, which is mostly used for explaining long-term volatility over the time, is employed instead for spatially referenced housing data. In addition to this, the architectural factors are introduced as an unexplained or irrational in this research. This results in a model that attributes spatial trends or bubbles to the architectural factors.

There are two main reasons for looking at the architectural factors and the housing market value spatial bubbles in parallel. Firstly, urban and planning design, being a part of architectural factors, as well as an art and science of creating space, actually define space and best use of it, resulting in spatial bubbles. The nature of urban design suggests bubble formation rather than scattered value distribution (Asabere et al., 1989; Nase et al., 2015). Secondly, even if looking at the architectural

objects more individually, they are highly affected by various externalities and spillovers of value of each other. This suggests that the value of the built environment extends to its closest proximity (Ahlfeldt and Mastro, 2012; Kauko, 2003). These assumptions confirm that the spatial trends tend to end up in the bubbles rather than scattered.

### 1.2.2. The identification of spatial bubbles in the housing market[4]

As described before, there is great interest in identifying and modelling the housing market bubbles over time. However, the spatial dimension of those bubbles gets less attention. While building on the theory of market equilibrium and formation of market bubbles, this research focuses on the spatial bubbles of apartment market value inside the city. Although the spatial dimension of the housing market value and bubbles has been acknowledged by Blank and Winnick (1953), Can (1990), Roehner (1999), Zietz et al. (2008), Sun et al. (2017), Glaeser (2017), a hypothesis was raised that the spatial dependency can be attributed to the unexplained variance created by the architectural design factors of the selected projects in a city. This approach adds another dimension to the phenomena of the housing market value spatial dependency and bubbles.

It is clear that some areas are more prone to the bubbles (Roehner, 1999; Sun et al., 2017). The research looks at a city scale where aggregated market value can "hide" or "mutate" bubbles; therefore, the spatial bubble is introduced. The process of spatial bubbles identification appears to be opposite to the house price index calculation. Instead of aggregating prices of various architectural objects, this research tries to deconstruct those aggregated values into the areas that contribute to the aggregated market value more significantly and areas that are lagging. The main focus of the following research is to capture this phenomenon while looking at the housing market data as a 3D map rather than 2D graph.

According to the literature review, the bubbles are mostly created by the supply and demand mismatch. The next question is what are the determinants of supply and demand. Of course, the housing market fundamentals (Capozza et al., 2002; Agnello and Schuknecht, 2009; Glindro et al., 2011) have a significant impact on the supply and demand, but this is true while talking about the aggregated values of a country or whole cities where there is no differentiation between the neighbourhoods and building level architectural objects (no submarkets). The question remains when looking at the neighbourhoods and buildings on a city scale. The spatial bubbles, being unexplained, originate from the architectural surroundings. Shiller (2007; 2014), Tupenaite (2017) has shown that people can look at other sciences, such as architecture, to explain the unexplained part of the market value variance across space. There is a significant group of unexplained architectural factors in the first place that

[4] This sub-section has been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

have influence on some places, making them more desirable and creating a supply and demand mismatch.

The theoretical background of the bubble formation can be based on a simple supply and demand model. As the housing market is slow, it never actually reaches the equilibrium market value, bounces up and down, therefore, creating upper and lower market bubbles (Figure 2) (Pilinkienė et al., 2020). Because of the nature of the real estate, which is fixed in place, supply and demand of a housing is not global, but rather more local. Therefore, the main idea behind this research is that you can apply this model either over time or across space. A hypothesis is raised that supply and demand are no less spatially dependent than time dependent.

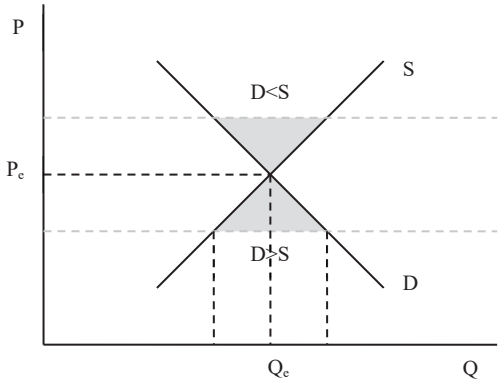



**Figure 2**. The housing estate market equilibrium, upper and lower market bubbles; source: Pilinkienė et al. (2020), figure modified by the author

The bubble appears when the housing market value deviation from the fundamentals increases irrationally according to the rational expectations theory (Smith and Smith, 2006; Rosser, 1991; Cameron et al., 2006; Wiedemer et al., 2009; Baker, 2002; Garber, 1990; Glindro et al., 2011; Glaeser et al., 2008) or situation when further change of market value in the same direction is expected to continue according to the irrational expectations theory (Kohn and Bryant, 2010; Case and Shiller, 2003; Shiller, 2000; 2002). A bubble cannot be explained by the economic fundamentals; however, it should have a reason, but the one that does not have origins in the economics. This explains why the bubble is seen as unexplained or irrational from the economic point of view; however, it can have an explanation coming from the other fields of science. In the context of this research, the architectural design factors are those unexplained reasons.

Spatial bubble can be defined as an irrational deviation of a housing market value from its fundamental value when measuring across space at a fixed moment in time, therefore under the same macroeconomic conditions. Spatial bubbles can be seen as different real estate cycles in different locations; however, those locations should appear under the same macroeconomic conditions. This conforms *ceteris*

*paribus* assumption and allows to focus on the spatial dependency only. Therefore, spatial bubbles are introduced in the city in this research. This research argues that such cycles in the city deserve their own conceptual notion, i.e., the spatial bubble. Identifying spatial bubbles in a country or a group of countries can be tested; however, this would raise a question about conforming *ceteris paribus* assumption that all macroeconomic conditions are the same and is not in the scope of this dissertation.

The economic intuition behind the spatial bubbles draws attention towards the interrelationships between the architecture and economics. The hypothesis was raised that the observed unexplained variance across space, created by the changes in supply and demand, can be attributed to the architectural factors. The model applies to the city scale microenvironment. It helps to explain the spatial bubbles in the city, because local supply and demand mismatch in the city creates local bubbles. This is quite intuitive when looking at the housing market value. The architectural factors, spreading across urban and planning level and building level, appear when searching for reasons behind the changes in demand. Shiller (2014) has suggested looking at other sciences while trying to explain the market bubbles. Moreover, it is clear that certain architectural factors can increase or decrease supply, especially in the urban planning where the actual supply of housing or other functions are being modelled. This evolves to the introduction of spatial bubbles.

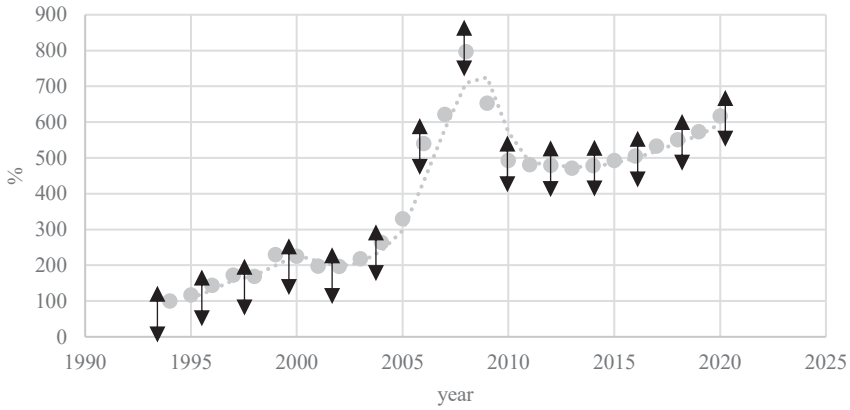



**Figure 3**. The hidden variance across space in Ober-Haus Lithuanian apartment price index (OBHI) (1994 = 100); source: Ober-Haus (2020), figure modified by the author

The housing bubbles over the time have been seen as a significant phenomenon while looking at the aggregated values in the time series of apartment price indexes (Figure 3); however, the time series graph is "hiding" variance across space or spatial bubbles. House or apartment price indexes are good for macroenvironment; however, if looking at the city scale, the aggregated values become inaccurate. Every point in the time series graph hides further variance across space. The variance across space of the selected apartments market value in Vilnius at a fixed moment in time is presented in the empirical research section. Further empirical research delves deeper

into the spatial dependency of apartment market value while incrementally removing the explained or rational variance.

### 1.2.3. The multiple dimensions of the housing market value[5]

This study aims to measure the unexplained variance across space of apartments market value, which may be seen as spatial bubbles. However, places with different supply and demand levels are a kind of submarkets. The segmentation based on the buyers' properties (demand) or architectural objects properties (supply) creates a kind of submarkets as well. While initially submarkets were supposed to be based on the position in the city, submarkets can be based on buyers' income, type of housing or certain cultural aspects (Buitelaar and Shilder (2017); Blank and Winnick (1953) have observed examples of this. To sum up, supply, demand and resulting submarkets, expressed as various dimensions of volatility over time (1), variance across space (2), shift/differences between segments (3) and other possible dimensions, are the core groups of determinants of the housing market value (Figure 4).

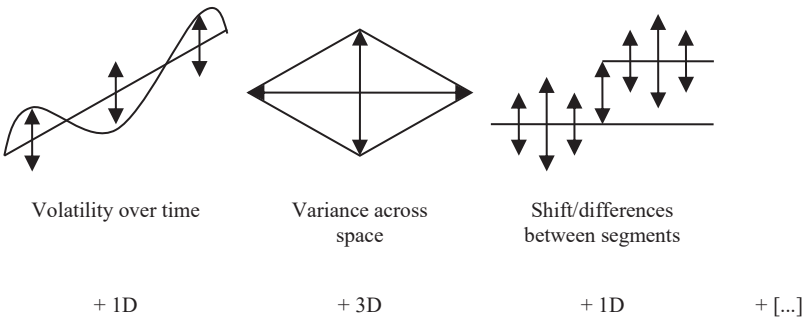



**Figure 4**. Multiple dimensions of the housing market value; source: created by the author

The theoretical background of various dimensions of the housing market value analysis could be prepared (Figure 4), which would significantly improve the understanding of the housing market value determination process. This research proceeds with analysing the variance across space only.

*Conclusions*. Multiple dimensions of a housing market value exist: volatility over time, variance across space, shift/differences between segments (fixed effects of segments) etc. The variance across space is no less significant than the volatility over time, which brings the concept of spatial bubbles. This dissertation focuses on the variance across space only in the following research.

[5] The 1st and 2nd paragraphs of this sub-section have been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

## 1.3. The outlines of architectural factors

### 1.3.1. The architectural aspects of the real estate economics[6]

Architecture should shape a human friendly space combining form and function. Space is a limited good with strictly defined size, features, and patterns, without the possibility of multiplication, which in turn creates competition and conflicts in the process of space management. Therefore, it is necessary to search for an appropriate and optimal way to use the space in order to determine the best possible function for a given area, generating "the highest value" and "the best use". Although architecture can be seen in many ways, the definition of architecture as art and knowledge of space is used and extended in this research. Architecture is not a physical object but rather a space that is functional and represents "the best use".

The notion of architectural factors in this study refers to the quantitative and qualitative measures of a built environment that can be taken to reflect that "best use". It is interesting that particular measures are neither positive nor negative in nature. For example, building intensity might be considered positive or negative depending on the location and use, as well as social, political and cultural background. Being location specific, architectural factors are hard to define; however, it is the essence of architecture to generate "the highest value" for a given area. For example, if there is limited space, as mentioned before, and limited resources to build a housing block, the question arises whether it be "the best use" to allocate all resources to build housing units or would it be better to leave space for a park or create communal space. Similarly, is it worth adding a non-structural layer for the façade complexity rather than saving on the investment or building more housing units instead. The idea of these factors becomes even more complicated when considering this housing block as an externality or public value (public good) to the inhabitants and visitors of a district or the whole city. The hypothesis is raised that the architectural factors can influence individual, economic and public policy outcomes.

In addition to this, the field of architecture may be referred to in the following senses:

1. *The widest sense* (the widely speaking sense) (from urban and planning to building and interior non-design and design properties);
2. *The narrower sense* (the narrowly speaking sense) (mainly building design and style properties).

The focus is on the scope of the design tasks that an architect may carry out. The widely speaking definition often includes the design of the total built environment from the macro level of urban and planning to the micro level of building. The object of architectural design is everything that shapes the space around people whether inside or outside, whether it is a building or other structure. As opposed to this,

[6] This sub-section has been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., Tanas, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: A methodological framework. *Journal of international studies, 13*(4), 38–53. doi:10.14254/2071-8330.2020/13-4/3

narrowly speaking, architecture is just buildings in space. For example, a new bridge is proposed. This would reduce the transportation costs in the city. This would alter the attractiveness of some areas for shopping and services, increase the potential for advertising and improve the investment background. This would have an impact on the housing characteristics in that area, therefore, changing the variables in hedonic house price models. This research views architecture in a broader sense, as defined by space, because it includes all the surroundings, e.g., a system of streets and bridges or districts and buildings, including the outside and the inside.

Architectural factors could include:

(1) *Spatial dependency, spillovers of value, externalities*. The problems of spatial effects have been ignored in the real estate analysis to an extent. However, there has been done some research to identify the house price determinants regarding their location and surroundings (Cellmer and Trojanek, 2019; Trojanek, 2016; Trojanek et al., 2018; Trojanek and Huderek-Glapska, 2018; Trojanek et al., 2019). This confirms that the real estate data is highly spatially dependent. In recent decades, spatial econometrics was used to incorporate neighbourhood dynamics and spillovers of house prices into the traditional hedonic model (Anselin, 1988; Can, 1990; Le Sage, 1998; Le Sage and Pace, 2009; Wilhelmsson, 2002, 2004). Other spatial econometric approaches, such as the distance to urban focal points in the city, have been tested, and their influence on the prices confirmed (Gat, 1998; Gong et al., 2016). There has been research on how to incorporate those spatial econometric models better, comparing different spatial econometric methods (Stamou et al., 2017). The spillovers of value in micro scale environments have been studied as well. The research has shown that the houses designed by Frank Lloyd Wright (a famous American architect) have a positive effect on the prices of houses nearby (Ahlfeldt and Mastro, 2012). A price impact of attractive neighbouring buildings was captured as well with a computer vision technique (Glaeser et al., 2018). These interventions suggest that the buildings in urban environments are affected by the appearance of the buildings that surround them and their position related to the urban structure of the city.

(2) *Urban and architectural design quality factors*. Many studies have attempted to add qualitative factors or expert ratings to the hedonic regression models. One of the earliest studies by Hough and Kratz (1983) assessed the influence of architectural factors on the office rent prices in downtown Chicago by using the regression analysis. New commercial buildings that won architectural awards had a 22% rent premium; however, landmark status buildings, as a measure of good architecture for the older buildings, did not benefit and suffered from a price discount due to the difficulties in renovations and government permissions. Vandell and Lane (1989) evaluated the office buildings in Boston and Cambridge to understand the effect of good architecture on their construction costs, rent levels and vacancy rates. They have found that the better is the design quality of the office buildings, the higher is the rent; however, the relationship between vacancy rates and the design was weak. They surveyed architects and used disaggregation analysis to measure the quality of architecture. They as well acknowledged that good design usually costs more, but is not necessarily a must. This was followed by Asabere et al. (1989) finding a price premium for certain architectural styles in Newburyport, Massachusetts. Fuerst et al.

(2011) proved that the offices designed by famous architects had higher rent levels than those whose designer was less famous. The attractiveness of historic areas was estimated, including style and building type factors as control variables, in a model by Coulson and Lahr (2005). Different aspects of design quality in apartment units in the Belfast City Centre were evaluated by applying and extending the hedonic model to include building and urban level quality factors (Nase et al., 2016). The research was performed by measuring the price effect of the neo-traditional architectural style of buildings, which does affect the willingness to pay (Buitelaar and Schilder, 2017). All these studies linked architectural factors to the value of buildings, and they mostly found a positive relation between the good design and the real estate market value.

(3) *Heritage aspects*. Architecture is perceived by people through their mind and memory; therefore, the collective memory gives meaning to places, altering the valuation of the real estate. There are various hedonic price analyses that look at the historic buildings. A price premium was found in cases that involved the listed buildings, neighbouring buildings to the listed buildings and cultural historic site areas (Lazrak et al., 2014). The same was observed in the historic districts in New York (Been et al., 2016). In a recent study by Rudokas et al. (2019), the landmark buildings were more expensive to maintain, therefore, resulting in lower rent prices. However, they act as positive externalities for neighbouring buildings. The research was conducted to analyse the heritage aspects, such as the status and features of a building or historic built environment, as well as influence on the real estate prices using the hedonic price method. While no significant influence on the prices was found regarding the heritage status of a building, the heritage in general played an important role in the price of the new buildings that were being developed in the surrounding area of the heritage buildings or environment. The authors have noticed the spillovers of value of heritage buildings that resulted in a significant increase in the neighbourhood house prices (Rudokas et al., 2019). The influence of the heritage aspects of architecture to the real estate market value was found in most cases, in particular when considering new buildings adjacent to the listed buildings and historic site areas.

(4) *Sustainability*. The need to evaluate the effect of architectural factors on the value of sustainable houses is addressed. The architectural design integrates a great variety of decisions in a building project, including orientation, window placements, space configuration and the choice of finishing materials (Fadaei, 2015). Good design can attract clients for sustainable houses, therefore, resulting in price premiums for investors of sustainable houses. If people know that they can save 25% on energy bills by buying a correctly solar orientated house, they will become motivated to select that house over the same house with the wrong orientation, contributing to the modern environmental discourse (Rashkin, 2010). The evidence of the built environment quality on the environmental outcomes was found in various other studies as well. Urban form has an impact on the energy consumption (Ewing and Rong, 2008; Ratti et al., 2005; Chen et al., 2011; Lee and Lee, 2014), mobility and services in the city (Zhou et al., 2013; Nakamura and Hayashi, 2013). Urban design and landscape design have an impact on the microclimate (Bowler et al., 2010; Ko and Radke, 2014; Jamei et al., 2016), air pollution and noise (Honold et al., 2012). The design of a built

environment is strongly related to the used material and embodied energy. Generally, a great deal of architectural solutions can contribute to achieve the sustainability goals in the real estate economics.

(5) *Public value of architecture. Architecture as non-market or public good*. Referring to architecture as a public good in a city, the value to its inhabitants and tourism may be captured. Scerri et al. (2019) noticed that the special local characteristics of place are captured and enhanced by the architectural factors, and the tourists are attracted to consume its unique design qualities. As with other non-market goods, tourist expenditure is not the explicit objective of architecture; however, architects, city municipalities and cultural organizations are aware that architecture is a visitor attraction on its own. This makes architecture an externality or public good that contributes significantly to the economic activity. In their study, Scerri et al. (2019) attempted to calculate the overall economic impact of a building annually. These included such examples as the Guggenheim Museum Bilbao, the Sydney Opera House and the Gehry-designed Dr. Chau Chak Wing Building, the latter being worth somewhere between AUD 48.8 and AUD 97.6 million to the economy annually (Scerri et al., 2019). The consumption of space by tourists and their mobility highly influences the economic activity in cities. The pattern of consumption is highly influenced by the positioning of architecture landmarks, public space and urban design structure (Aranburu et al., 2016). There is an implicit market for the environmental goods in the city. People do not explicitly purchase non-market goods; however, people do purchase other goods, for which the demands are related to non-market goods. For example, the environmental quality can influence where to live, work and relax (Champ et al., 2017). Regarding the architectural factors, people do not explicitly purchase architectural quality, or widely speaking, architecture. Thus, architecture, or some part of it, may be perceived as a non-market good. The real estate market links to the non-market goods make it possible to infer values for the demand of architecture as a non-market good that is revealed through the housing purchases.

*Other built environment outcomes*. The value that the built environment generates was revealed by a systematic study by Carmona (2019). It was backed up by 271 research studies that were included in the review focusing on the added value of quality of space. The full range of the public policy dimensions covered by Carmona (2019) are (1) health, (2) society, (3) economy and (4) environment (see sub-section 1.3.4.).

### 1.3.2. The interrelationship between architecture and built environment[7]

In the search for the mechanism of the influence of architectural factors on the housing market value, the objects of the built environment become a mediator

[7] This sub-section has been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., Tanas, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: A methodological framework. *Journal of international studies, 13*(4), 38–53. doi:10.14254/2071-8330.2020/13-4/3

between architecture and economics. The interrelationships between architecture and the built environment, presented in Figure 5, are as follows:

1. Architecture – attribute of the built environment that is a capital or a product (investment or consumer good) (it is tangible, shapes physical structures and is a part of the market goods and relates to the hedonic price models).
2. Architecture – art, design, image, style, vision or orientation that influences human economic behaviour (it is intangible and abstract and, thus, difficult to incorporate into the market evaluation, partially acts as a non-market good and relates to the studies about quality factors, non-market and public goods).
3. Architecture – a significant part of the ecosystem where everybody lives in (relates to the studies about sustainability).

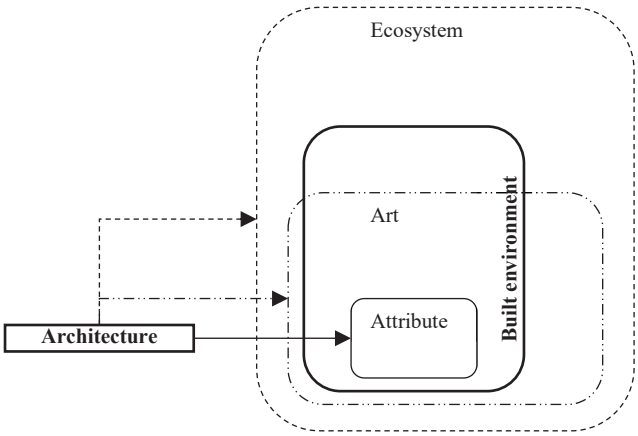



**Figure 5**. The interrelationship between architecture and built environment; source: created by the author

The first interrelationship comprises the narrowly speaking sense of architecture. This shows that the architectural factors have an influence on this large market. The housing market is larger than the value of the entire stock market in most countries, particularly in the Baltic States (Jadevicius, 2016). In the Baltic States, the amount of outstanding housing loans to the households was EUR 19.0 billion in 2018 (Hypostat, 2019), and the market capitalization of the listed companies was EUR 6.7 billion (Nasdaq, 2020). The architectural assets hold tangible and intangible value. While the first interrelationship is about shaping the tangible assets, the second interrelationship is about the intangible value of buildings, which can be described in various forms, including the aesthetic and cultural values (Scerri et al., 2019), the sense of place and the historical and social meaning (Hayllar et al., 2008).

Regarding the third interrelationship, architecture is a significant part of ecosystem where everyone lives in and its sustainability. Architecture may not be replaced by other products or services even in the long term. The cities, public spaces

and shelters are the main pillars that people relate to. The concept of sustainability should not be based only on the market models, especially in the short term, as the influence of the given nature of the universe is dominant in the architectural design. The way the space is managed has a significant impact on the functioning of the economy and the value of resources (the land, natural and cultural landscape and the environment).

Subordination of investment procedures to the principles of sustainable development is a source of benefits for the economy (reduction of losses resulting from wrong administrative decisions and improvement of investment processes), social benefits (reduction of social conflicts and higher quality of life) and benefits for the natural and cultural environment (reduction of negative consequences for the environment, better value protection in both spheres of heritage). To summarize, the first interrelationship shows that architecture deals with stock that has quantitative significance in microeconomics and macroeconomics. The latter two interrelationships show a broader influence on the society and economic behaviour.

Through these interrelationships, the influence of architecture on a built environment may be:

1. *Quantitative*. The architectural factors have an influence on the effectiveness of the geometry of a building, the heating and cooling capacity, the natural lighting and the use of land and materials. As described before in this work, the orientation of a building, amount of glazing, thermal capacity and types of materials have impacts on the overall performance of a building (Fadaei et al., 2015).
2. *Qualitative*. The architectural factors are the influential generators of value. The transferred value is highly intangible and, therefore, impossible to quantify. However, later in the process, health, social, economic and environmental outcomes can be quantified.

Functional technical decisions in tandem with the aesthetics from architecture are expected. There should be a balance between the quantitative and qualitative measures in architecture, as going for the maximum rate in the quantitative assessments would render all buildings the same. Although there is evidence that various quantitative and qualitative architectural factors have an influence on the real estate market values, the influence of architectural factors, in a broad sense, on a housing market value is not structured. The architectural factors in the econometric models are taken as immutable and fixed; therefore, little research has been done to simulate different scenarios of architectural design and forecast possible impacts.

When talking about the influence on the housing market, the influence must be quantitative and expressed through the market value or various statistics of location and macroeconomic factors. The influence of the built environment on the housing market is quantified and highly influenced by the used real estate valuation methods; however, the accuracy and the mechanism of those methods are not in the scope of this study.

The architectural factors should not be assumed to be exogenous over the time. There are many omitted variables that influence architecture and a housing market at the same time. The market value of the housing tends to move together with other

asset prices. Real estate, especially housing, is consumption and investment at the same time, thus becoming a consumer choice and speculative asset. There may be larger players, such as the credit supply, GDP or interest rates, that have an overriding influence on the housing consumption. There may be certain trends or desires in the society, resulting in the irrational human behaviour that is hard to explain in the econometric models. Therefore, the mechanism of the influence of architectural factors on the housing market value, as described in this study, should be considered at a fixed time as capable of shifting over the time.

### 1.3.3. The concept of the housing market value[8]

A distinction between two concepts of value is made by the philosophers:

1. *Intrinsic value*. "That which is desirable or worthy of esteem for its own sake; thing or quality having intrinsic worth" (Webster's New World Dictionary, Third College edition); "if it is valuable in and for itself – if its value is not derived from its utility, but is independent of any use or function it may have in relation to something or someone else … an intrinsically valuable entity is said to be an 'end-in-itself', not just a 'means' to another's ends" (Callicott and Shaner, 1989).
2. *Instrumental value*. The value, according to this concept, lies in its contribution to some other goal, a "mean" to some other end or purpose (Costanza and Folke, 1997).

The housing market value reflects a mix of these two concepts. The usefulness of the housing is captured by its instrumental value; however, architecture, as the art and science of designing a space, can hold intrinsic value that may affect the willingness to pay. It is difficult to draw a separation line here, but, for example, a traditional shape, particular style, or material of a house may have more intrinsic value compared to the plan arrangement or number of floors, although some properties that are considered intrinsic could have a halfway instrumental explanation.

In the context of social, cultural, economic and environmental values, the built environment occupies a core position that shapes people behaviour. Therefore, the concept of the housing market value can be approached from two different perspectives:

1. *The value that the built environment generates* as a measure of built environment outcomes;
2. *The determinants of market value* as a measure of factors influencing the housing market value.

These two approaches are presented in the following paragraphs of this sub-section.

[8] This sub-section has been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., Tanas, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: A methodological framework. *Journal of international studies, 13*(4), 38–53. doi:10.14254/2071-8330.2020/13-4/3

**Table 1.** Public policy dimensions; source: Carmona (2019)

| | Public policy dimensions |
|---|---|
| Health | A1. Greenness and physical health<br>A2. Greenness and psychological well-being<br>A3. Place quality and mental health<br>A4. Walkability, active travel and related health<br>A5. Place quality and physical health |
| Society | B1. Street layout and crime<br>B2. Environmental design and crime<br>B3. Street design and safety from collisions<br>B4. Place quality and livability<br>B5. Urban vitality<br>B6. Inclusivity and social capital<br>B7. Enabling environments<br>B8. Place quality, play and learning |
| Economy | C1. Property values and green space<br>C2. Residential property values and urban design<br>C3. Commercial property values and urban design<br>C4. Streets, public realm and economic value<br>C5. Economic development and regeneration<br>C6. Public spending (and savings) |
| Environment | D1. Urban form, density and energy use<br>D2. Transport, technology and carbon reduction<br>D3. Thermal comfort, cooling and pollution<br>D4. Ecology and resilience |

*The value that the built environment generates*. This was revealed by a systematic study by Carmona (2019). It was backed up by 271 research studies that were included in the review focusing on the added value of the quality of a space. The full range of the public policy dimensions covered by Carmona (2019) is presented in Table 1. The collective evidence on place value is a collection of health, social, economic and environmental outcomes. The way places are designed plays an important role in delivering better physical health, mental health, better fitness, greater daily comfort and enhanced quality of life.

The social evidence corresponds to fewer accidents, social integration, lower rates of crime, better educational outcomes, enhanced street level vitality and sociability, stronger civic pride and greater inclusiveness. Economic outcomes consist of property uplift and reduced vacancy, viable investments and extended regeneration benefits, reduced public expenditure, higher local tax takes, lower costs of living and higher productivity.

The environmental benefits from place value include reduced energy use and associated carbon emissions, adaptive reuse, a viable local exchange network, reduced heat stress and enhanced thermal comfort, reduced waste and pollution, greater resilience and ecological diversity (Carmona, 2019). Some economic outcomes are quantitative and refer to the market value instantaneously to see the impact on the housing economics. While the health, social, environmental and some of other

economic outcomes are beneficial to the microeconomic and macroeconomic environment overall, their impact on the housing economics is collateral through micro and macro factors, as presented in the following sub-sections of this thesis.

A problem of differentiating types of value can be discussed further. In the economic context, value is usually interpreted as a monetary amount for an exchange between a willing buyer and a seller in an open market. However, two main types of value can be defined:

1. *Value in exchange* is the quantity of other commodities (normally cash) that a commodity can be swapped for (Carmona et al., 2001). This is what is generally called market value and is often related to the concept of price (Nase et al., 2015).
2. *Value in use* is often associated with the concept of worth or pleasure that a commodity generates for its user. It is important to say that worth is not the same as the price, as there are various factors in the housing market that are not perfect (inefficient). The valuation of the real estate as well differs widely at the international level (Nase et al., 2015).

The International Valuation Standards Council (IVSC) and Royal Institution of Chartered Surveyors (RICS) define market value as:

> Market Value is the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion (RICS, 2019).

However, this definition can be criticized for being too money-centred and with little consideration of other (physical and social) dimensions (Nase et al., 2015). Therefore, a wider conception of value, including value in use and welfare, was applied in this study. Six different types of value of built environment were identified by Macmillan (2006):

1. *Exchange value*. Objects of built environments are commodities to be traded. The market price is the price that people are willing to pay for it.
2. *Use value*. The contribution of a built environment to the organizational outcomes, such as productivity, profitability, competitiveness and repeat business.
3. *Image value*. The contribution of a built environment to corporate identity, prestige, vision and reputation; creating organizational values of openness, design excellence and innovation; architectural factors working together with people to become part of a brand image.
4. *Social value*. Creating opportunities for positive social interaction, enhancing social identity and improving safety and security as well as preventing vandalism and crime.
5. *Environmental value*. Contribution to sustainability of a built environment by using the principles of adaptability and flexibility, robustness and low maintenance; the application of a whole-life cost approach.

6. *Cultural value*. Intangible phenomena, such as context, sense of place, symbolism, inspiration, and aesthetics, are considered.

The various types of value described above translate to the first value in exchange. "This translation process is based on interdependent economic factors that create value, namely utility, scarcity, desire and effective purchasing power" (AI, 1996).

> Utility is the ability of a good to satisfy needs. Scarcity is the supply of an item relative to the demand for it. If demand is constant the scarcity of a commodity makes it more valuable. In the case here, reduced quantities of a quality (urban design) product due to initial investment costs reflect its price in the market. Because it is inefficiently priced, urban design (as a public good product) is undersupplied by property development and house building industry. Desire is a purchaser's wish for a commodity to satisfy needs beyond the essential required to support life. This is considered in direct relation to quality as the willingness to pay a higher price for higher utility. Finally, effective purchasing power is the ability of purchasers to participate in the market (Nase et al., 2015).

This justifies the definition of the Royal Institution of Chartered Surveyors, which states that the market considers all types of value when defining an exchange value, market value or price. This is based on the utility theory as all types of value together maximize the user utility (Nase et al., 2015). It is difficult to confirm, however, that none of the value is lost during that translation; therefore, the market value of the housing may not reflect the whole set of described values.

*Determinants of the market value*. Looking from the perspective of the housing market value, hedonic theory is based on the idea that the price of any house represents the price for a bundle of factors (goods). Those factors (goods), according to Dubin (1988), can be grouped into three main categories:

1. Location factors are the characteristics that describe the geographical location of the object or its location relative to the other objects.
2. Structural factors are the attributes of the house (size, rooms, age etc.).
3. Neighbourhood factors are the characteristics that describe the socio-economic and physical neighbourhood properties (pollution, noise, crime etc.) (Can, 1992).

The location and neighbourhood factors that influence the market value of houses are an outcome of the structure of the same houses and are not entirely exogenous. This is based on the theory of structuralism, which states that the structure of elements may acquire new values compared to the sum of the values of the individual elements. Those new acquired values are location and neighbourhood factors, as presented in Figure 6.

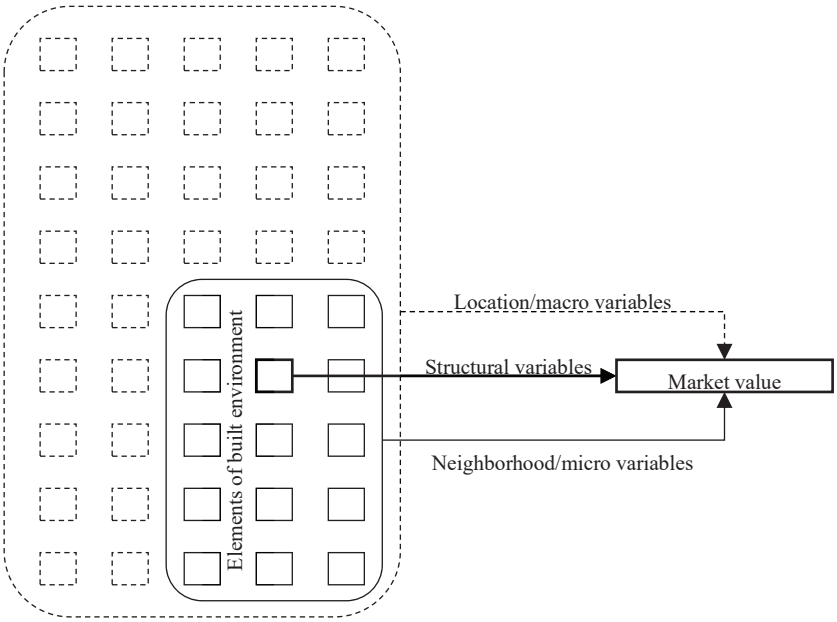



**Figure 6**. Structural, location and neighbourhood factors; source: created by the author

The structure of determinants of the housing market value is presented in Figure 7. The determinants of the housing market value are constructed in three main categories. The base market value, determined by the structural factors, is modified by micro modifiers, determined by the neighbourhood factors, and macro modifiers, determined by the location factors.

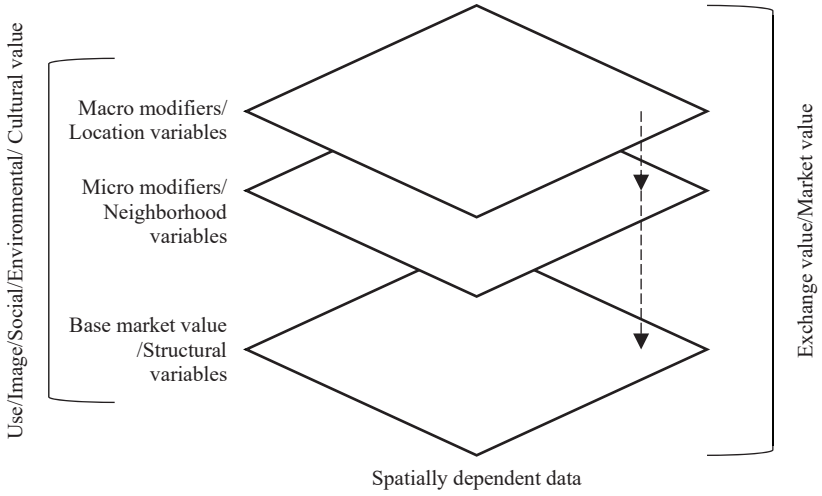



**Figure 7**. Layers of the housing market value; source: created by the author

Moreover, it is worth noting that, although "market value" and "price" can have slightly different meanings, they are used as synonyms in this study.

### 1.3.4. The concept of architectural factors[9]

In this sub-section, three main areas of literature are reviewed: (1) the documentation for the real estate appraisal, (2) the scientific literature on the determinants of the housing market value, (3) the scientific literature on the value that the built environment generates. The aim of this review is to understand the range of architectural factors and variables in order to define and classify them better. Although the fundamental variance of the housing market value can be explained by various basic hedonic models, there is still an unexplained part of that variance, which many studies are trying to address.

*The documentation for the real estate appraisal*. There are three main valuation approaches: (1) market approach, (2) income approach, (3) cost approach. Other approaches that have been defined in the international standards and European standards, or a combination of approaches above could be used as well (SRL, 2017; MFRL, 2020; IVSC, 2021). The concept of having these different approaches tries to solve the fundamental question of why buildings with similar cost, taking into account the income that they can generate, end up with different market value. Theoretically, the income and cost approach should be objective, while the market approach should include the subjective judgment of buyers and sellers. The misalignment of estimated market value between the different approaches may indicate the unexplained variance that assessors deal with.

This research looks at the architectural factors across various approaches to the housing market value. (1) The market approach compares nearby transactions; however, the main problem of the housing not being homogenous appears; therefore, the corrections are needed to control for individual heterogeneity. Although the market approach includes architectural factors, subjectively judged by buyers and sellers, comparing the most accurately matching housing, the ability to control for architectural factors could potentially improve the market approach. Numerous factors could be included if granular enough data existed. (2) The income approach calculates the potential income; therefore, the architectural factors have an influence on the attractiveness and image, resulting in higher income. The income approach is not relevant when buying property for personal use but becomes important when investing in housing and expecting to rent it. The architectural factors could be crucial in long term, because high carrying and transaction costs in the context of changing housing trends limit the ability to sell. (3) The cost approach calculates the replacement cost and modifies it for the location. Depreciation should consider the physical and economic lives of the asset (IVSC, 2021). While physical depreciation

[9] This sub-section has been quoted verbatim from the following source: Skripkiūnas, T., & Navickas, V. (2023). Architectural factors influencing a housing market value: A theoretical framework. *Real estate management and valuation, 31*(1), 25–35. doi:10.2478/remav-2023-0003

is relatively easy to measure, the economic depreciation is more abstract and integrates the socioeconomic changes about how people are using the built environment. Moreover, the correction for location is crucial and must rely on the exogenous coefficients from the other valuation approaches. The cost approach is very intuitive because it is based on the cost of construction; however, it can be the least accurate and needs modifications and corrections to control for the economic value, location and many potential architectural factors. Architectural factors can act similarly to the economic depreciation: changing conditions and market trends over time or across space can strongly influence the market value.

Mass appraisal is a good example of structuring the main factors that are influencing the housing market value. Considering the Lithuanian example, mass appraisal of the real estate is performed in stages. The market approach is used to create value maps and zones. Those value zones are essentially spatial bubbles of the real estate market value at a country or city scale. According to those value zones and other known factors, the models with coefficients are created for specific groups of buildings (OGRL, 2015). Buildings are grouped according to their function. The core characteristics are included in those models: location, function, physical properties, such as the total floor area, number of rooms, year of construction and others, based on the information that is available in the real estate registry, mechanical equipment, land value coefficient, other known factors (SECR, 2021). The important point is that the market approach is initially needed to create value maps and zones. The variance of market value between those zones is unexplained, it merely reflects the market. However, the building is seen without any architectural detail, interior or volumetric features, as if all buildings are the same architectural quality wise.

The cost approach is used as well to verify the market approach in the mass appraisal. A sequence of values is calculated using the cost approach: (1) the construction cost of the real estate; (2) the replacement cost of the real estate, the construction cost is adjusted to the depreciation percent for all years in use; (3) average market value, the replacement cost of the real estate is adjusted using the location correction coefficient. The latest registry entries, construction cost estimates and average life span estimates are used to evaluate the real estate by using the cost approach. A location correction coefficient represents the ratio between the market value and replacement cost in a particular value zone (OGRL, 2015). This is done to eliminate the unexplained variance, which defines the scientific problem of this research.

*Scientific literature on the determinants of the housing market value*. The use of architectural factors and variables in scientific articles is analysed. The factors that are used in the research studies are presented in groups, ranging from building level non-design factors to the neighbourhood level urban design and urban planning factors. The architectural factor stands for the expression of some properties, influencing the housing market value, and the architectural variable stands for the actual measurement of those properties. The architectural factors across the determinants of housing market value are widely acknowledged in literature. However, their significance, classification and hierarchy are not well-established.

The following architectural factors are found in literature:

(1) Building level non-design factors are very much straightforward, i.e., these are the basic properties of the housing:

(1.1) Total floor area or living area of the building, apartment etc.; age or construction year; floor number; total number of floors; total number of living units; land plot size in the case of complete buildings; number of rooms/bedrooms; number of bathrooms/half bathrooms; number of kitchens; perimeter and footprint of the building; parking/garage facilities on-site.

(1.2) Number/area of balconies; number/area of terraces; amount of storage facilities; number of fireplaces; lift; reception.

(1.3) Heating/ventilation/cooling equipment (natural gas, heat pump, solar etc.); safety door; security system/alarm.

(1.4) Physical status or maintenance level of a building, apartment etc. (inside/outside); exterior condition; interior condition; renovation status/date; owner occupation status; land ownership type (Glaeser et al., 2018; Stamou et al., 2017; Nase et al., 2016; Coulson and Lahr, 2005; Buitelaar and Schilder, 2017; Asabere et al., 1989; Vandell and Lane, 1989; Rong et al., 2020; Fuerst et al., 2011; Gat, 1998; Rudokas et al., 2019; Been et al., 2016).

Some factors are less straightforward in their nature and are slightly closer to the design factors:

(1.5) Building/housing type (detached, semi-detached, apartment etc.); building height; construction type/materials; parking facilities type (parking place, carport, garage etc.); fence (dummy); porch (dummy); office class (A, B etc.); view rating/orientation (street, sea, front, airy, corner, inside etc.) (Buitelaar and Schilder, 2017; Asabere et al., 1989; Fuerst et al., 2011; Stamou et al., 2017; Glaeser et al., 2018; Gat, 1998; Rudokas et al., 2019).

Moving from the above-listed non-design factors towards the architectural design factors. (2) Building level architectural design factors are as follows:

(2.1) Visual appearance and design evaluation, assessor/expert: exterior finish type; interior finish rating; quality of design (dimensions: decorativeness or embellishment of the facade; colour and texture of surface materials; quality of surface materials; differences in configuration or shape of the building, massing and fenestration, including the presence or absence of site amenities); quality of components (elevator, lobby, finishes etc.) (Glaeser et al., 2018; Vandell and Lane, 1989; Gat, 1998).

(2.2) Visual appearance and design evaluation, computer: exterior image features; interior image features (Glaeser et al., 2018).

(2.3) Architectural style/type: building style (traditional, contemporary, cottage, cape cod, townhouse, neo-traditional, Victorian etc.); kitchen style; bathroom style; historic period (pre-war etc.); exterior type (frame, stucco, brick, veneer, stone etc.); roof type (gable, hip, gambrel, mansard, pitched, shed, mixed etc.).

(2.4) Volume type/external design features (diagonal intersection, curvature, setbacks, podium extrusion etc.); building type (single-family detached, single-family attached, two-family home, loft building, apartment etc.) (Glaeser et al., 2018;

Coulson and Lahr, 2005; Buitelaar and Schilder, 2017; Asabere et al., 1989; Been et al., 2016; Rong et al., 2020).

(2.5) Recognition and awards: designed by awarded architects/firms; designed by top rated/signature architects/firms (Rong et al., 2020; Fuerst et al., 2011).

(2.6) Heritage object: national heritage designation; local heritage designation; local district heritage designation; unique project (identity and marketing); unique architecture (compared to the standard uniform housing projects); completeness of architectural appearance; altered building (Rudokas et al., 2019; Been et al., 2016; Coulson and Lahr, 2005).

The next step would go to the larger scale (3) neighbourhood level non-design factors: number of civic points; distance to green space; different urban green space types and sizes, noise levels, access to subway, distance to civic points (park, business district, plaza, route, station etc.); density of services; density/availability of public transportation (metro, electric trains etc.); density of manufacturing; distance to expressway; distance to central city; travel time to central city; distance to sub-central city; travel time to sub-central city; number of parking places within specified distance from the structure (Nase et al., 2016; Asabere et al., 1989; Gat, 1998; Gong et al., 2016; Vandell and Lane, 1989; Stamou et al., 2017; Trojanek et al., 2018; Czembrowski and Kronenberg, 2016; Trojanek and Huderek-Glapska, 2018; Trojanek and Gluszak, 2018).

(4) Neighbourhood level urban design and urban planning factors:

(4.1) Urban pattern/form/structure/coherence: connectivity; urban density; attraction index; spatial centrality indices of points of interest; plot type (corner, irregular etc.); view from the office; commercial land use; other non-residential land use; walkability/walk score; appropriateness to the surroundings (finishing/identity/material quality/fenestration/massing/height/condition) (Nase et al., 2016; Aranburu et al., 2016; Been et al., 2016; Gat, 1998; Coulson and Lahr, 2005; Rong et al., 2020).

(4.2) Heritage area/complex: heritage territory/historic zone designation; heritage territory/historic zone designation buffer zone; amount of heritage (the intensity of urban heritage mass existing in the district); carrying the name of the designated area (identity); district (identity); street (identity) (Asabere et al., 1989; Rudokas et al., 2019; Coulson and Lahr, 2005; Been et al., 2016).

**Table 2.** Determinants of the housing market value; source: created by the author

| Groups | Architectural factors/variables | References |
|---|---|---|
| **Building level non-design** | | |
| Basic properties, non-design | Total area or living area of the building, apartment etc.<br>Age or construction year<br>Floor number<br>Total number of floors<br>Total number of living units<br>Land plot size in case of complete buildings<br>Number of rooms/bedrooms<br>Number of bathrooms/half bathrooms | Glaeser et al. (2018); Stamou et al. (2017); Nase et al. (2016); Coulson and Lahr (2005); Buitelaar and Schilder (2017); Asabere et al. (1989); Vandell and Lane (1989); Rong et al. |

| | | |
|---|---|---|
| | Number of kitchens<br>Perimeter and footprint of a building<br>Parking/garage facilities on-site<br>Lift<br>Reception<br><br>Physical status or maintenance level of a building, apartment etc. (inside/outside)<br>Renovation status/date<br><br>Number/area of balcony<br>Number/area of terrace<br>Amount of storage facilities<br>Number of fireplaces<br><br>Owner occupation status<br>Land ownership type<br><br>Heating/ventilation/cooling equipment (natural gas, heat pump, solar etc.)<br>Safety door<br>Security system/alarm | 2020; Fuerst et al. (2011); Gat (1998); Rudokas et al. (2019); Been et al. (2014) |
| Basic properties, less non-design | Building/housing type (detached, semi-detached, apartment etc.)<br>Building height<br>Construction type/materials<br>Parking facilities type (parking place, carport, garage etc.)<br>Fence (dummy)<br>Porch (dummy)<br>Office class (A, B etc.)<br>View rating/orientation (street, sea, front, airy, corner, inside etc.) | Buitelaar and Schilder (2017); Asabere et al. (1989); Fuerst et al. (2011); Stamou et al. (2017); Glaeser et al. (2018); Gat (1998); Rudokas et al. (2019) |
| **Building level architectural design** | | |
| Visual appearance and design evaluation, assessor/expert | Exterior condition<br>Interior condition<br>Exterior finish type<br>Interior finish rating<br><br>Quality of design (dimensions: "decorativeness" or embellishment of the façade; colour and texture of surface materials; quality of surface materials; differences in configuration or shape of the building, massing and fenestration, often referred to by the designers as "volumetrics", including the presence or absence of site amenities) | Glaeser et al. (2018); Vandell and Lane (1989); Gat (1998); Hough and Kratz (1983); Alfred and Mastro (2012) |

| | | |
|---|---|---|
| | Quality of components (elevator, lobby, finishes etc.) | |
| Visual appearance and design evaluation, computer | Exterior image features<br>Interior image features | Glaeser et al. (2018) |
| Architectural style/type | Building style<br>Kitchen style<br>Bathroom style<br>Historic period (pre-war etc.)<br>Exterior type (frame, stucco, brick, veneer, stone etc.)<br>Roof type (gable, hip, gambrel, mansard, pitched, shed, mixed etc.)<br>Volume type/external design features (diagonal intersection, curvature, setbacks, podium extrusion etc.)<br>Building type | Glaeser et al. (2018); Coulson and Lahr (2005); Buitelaar and Schilder (2017); Asabere et al. (1989); Been et al. (2014); Rong et al. 2020 |
| Recognition and awards | Designed by awarded architects/firms<br>Designed by top rated/signature architects/firms | Rong et al. 2020; Fuerst et al. (2011) |
| Heritage | National heritage designation<br>Local heritage designation<br>Local district heritage designation<br>Unique project (identity and marketing)<br>Unique architecture (compared to standard uniform housing projects)<br>Completeness of architectural appearance<br>Altered building | Rudokas et al. (2019); Been et al. (2014); Coulson and Lahr (2005) |
| **Neighbourhood level non-design** | | |
| | Controls for location | |
| **Neighbourhood level urban design and urban planning** | | |
| Urban pattern /form /structure /coherence | Connectivity<br>Urban density<br>Attraction index<br>Spatial centrality indices of POI's (points of interest)<br>Plot type (corner, irregular etc.)<br>View from the office<br>Commercial land use<br>Other non-residential land use<br>Walkability/walk score<br>Appropriateness to the surroundings (finishing/identity/material quality/fenestration/massing/height/condition) | Nase et al. (2016); Aranburu et al. (2016); Been et al. (2014); Gat (1998); Coulson and Lahr (2005); Rong et al. 2020; Nase et al. (2015) |
| Civic points | Distance to green space<br>Distance to civic points (park, business district, plaza, route, station etc.) | Nase et al. (2016); Asabere et al. (1989); Gat (1998); Gong et |

| | | |
|---|---|---|
| | Density of services<br>Density/availability of public transportation (metro, electric trains etc.)<br>Density of manufacturing<br>Distance to expressway<br>Distance to central city<br>Travel time to central city<br>Distance to sub-central city<br>Travel time to sub-central city<br>Number of parking places within 800 feet of the structure | al. (2016); Vandell and Lane (1989); Stamou et al. (2017) |
| Heritage area /complex | Heritage territory/historic zone designation<br>Heritage territory/historic zone designation (sale after designation)<br>Heritage territory/historic zone designation buffer zone<br>Heritage territory/historic zone designation buffer zone (sale after designation)<br>Amount of heritage (the intensity of urban heritage mass existing in the district)<br>Carrying the name of the designated area (identity)<br>District (identity)<br>Street (identity) | Asabere et al. (1989); Rudokas et al. (2019); Coulson and Lahr (2005); Been et al. (2014); Lazrak et al. (2014) |

The variables representing the architectural factors can be used as absolute values, intervals of absolute values, dummies and other. Many selected research studies in the literature review have controls for location or spatial dependency. This is not primarily an architectural factor, but it is the core ingredient, because location is inevitably associated with the architectural surroundings. Most common measures are latitude and longitude, neighbourhood or other spatial fixed effects used for spatial econometric models (Glaeser et al., 2018; Stamou et al., 2017; Buitelaar and Shilder, 2017). An extra layer of spatial dependency factors could be added controlling for the adjacent properties, i.e., value spillovers. Many studies in literature review as well have controls for temporal effects if data extends over a significant amount of time, during which the price has changed because of the macroeconomic or other external factors (Glaeser et al., 2018; Nase et al., 2016; Buitelaar and Shilder, 2017). The most common measures are transaction year or other time fixed effects. Furthermore, a polynomial articulation of some variables is used to enhance their significance. The most common measures that polynomial articulation is used for are age and the number of living units (Coulson and Lahr, 2005). Some selected studies in the literature review include the pairs of interactions of the selected variables.

*Scientific literature on the value that the built environment generates*. Another part of the research looks at the economic outcomes of the built environment rather than trying to determine its market value. The economic outcomes include architectural factors that result in: (1) influence on property values, (2) influence on economic value, (3) influence on economic development, (4) influence on public

spending. The following paragraphs go through place quality factors that result in specified groups of economic outcomes.

The following architectural factors that result in economic outcomes are found in literature:

(1) Direct influence on property values is one of the major economic outcomes. Scientific evidence of place quality factors can be found in literature:

(1.1) Green space: adjacency to the landscape with trees, forests, residential development with landscape integration or open landscape, presence of parks and plazas, amount of natural open space (Anderson and Cordell, 1988; Wolf, 2007; Li et al., 2016; Nilsson, 2014; Correll et al., 1978; CABE, 2005; Anderson and West, 2006; Kong et al., 2007; Zhang et al., 2012; McCord et al., 2014; Smith, 2010; Dewaelheyns et al., 2014; McConnell and Walls, 2005; Kopits et al., 2007).

(1.2) Urban design: walkability, street networks, diversity in form, mixed land use, density, proximity to retail sites, public transport, quality of street layout, quality of green space, sense of place, size of residential development (Diao and Ferreira, 2010; SR, 2010; SR, 2016; Song and Knaap, 2004; Matthews and Turnbull, 2007; CABE, 2003; Tu and Eppi, 1999; Ahlfeldt and Mastro, 2012; Thorsnes, 2000; Bowes and Ihlanfeldt, 2001; Bartholomew and Ewing, 2011; Levine and Inam, 2004; Yang et al., 2016; Cervero and Duncan, 2004; Whitbread, 1978).

(2) Influence on economic value is less directly related to the housing market value. There are some overlapping and some unique factors: streets layout, public realm: quality of street space, mixed use street environment, bike paths, expanded walking facilities (UN, 2013; Lawlor, 2013; Carmona, 2015; CABE, 2007; NYCDT, 2012a; NYCDT, 2012b; Carmona et al., 2017; CBRE, 2017).

(3) Influence on economic development is even less directly related to the housing market value. Scientific evidence of the influence of architectural factors for regeneration can be found: heritage based regeneration, high quality architecture, compactness and mixed use (Worpole, 2000; Bell, 2005; EH, 2002; Ahlfeldt et al., 2012; Spencer and Winch, 2002; Carmona et al., 2001; McIndoe et al., 2005; La Rosa et al., 2017; Ryan and Weber, 2007).

(4) Some place quality factors have influence on the public spending: walkability, distance to public transport, passive security, good street lighting, good maintenance (Zapata Diomedi et al., 2016; Litman, 2004; Leinberger and Alfonzo, 2012; Ewing and Dumbaugh, 2009; Glaeser and Gottlieb, 2008; CABE, 2009; Zhan and Chui, 2016).

**Table 3.** Value that the built environment generates; source: Carmona (2019), table modified by the author

| Groups | Architectural factors/Place quality factors | |
|---|---|---|
| **Green space** | | |
| Influence on property values | Good views from buildings;<br>Housing in the vicinity of landscaping with trees (especially large trees);<br>Trees and forest cover in development growth areas; | Anderson and Cordell (1988); Wolf (2007); Li et al. (2016); Nilsson (2014); Correll et al. (1978); CABE (2005); |

| | | |
|---|---|---|
| | Residential developments with stronger landscape integration;<br>Urban amenities and accessibility factors, such as air pollution, forest coverage, quality of public schools and commuting cost;<br>Open landscape amenities in residential areas;<br>Presence of structural green space in residential areas;<br>Greenbelt areas in neighbourhoods;<br>Presence of a high quality park;<br>Proximity to open space;<br>Type and size of open spaces;<br>Accessibility to parks and plazas;<br>Residential proximity to green spaces;<br>Proximity to parks and water bodies;<br>Urban green space proximity;<br>Natural open space proximity;<br>Presence and amount of parkland space;<br>Presence of permanently preserved open space in the residential areas;<br>Size and continuity of open space in the residential areas;<br>Types of open space (parks, greenways, forests and other natural areas) and location relative to households;<br>Size and location of open space | Anderson and West (2006); Kong et al. (2007); Zhang et al. (2012); McCord et al. (2014); Smith (2010); Dewaelheyns et al. (2014); McConnell and Walls (2005); Kopits et al. (2007) |
| **Urban design** | | |
| Influence on residential property values | Quality of green space (as opposed to the quantity or proximity), proximity to heritage, walkability, connected street networks, diversity in form, land use and transport;<br>Auto dominance (accessibility to public transport and jobs, connectivity and walkability);<br>Qualities of sustainable urbanism;<br>Permeability, connectivity, street layout;<br>Cul-de-sac streets layouts;<br>Investing in place-making;<br>Mixing land uses and parks into residential areas;<br>Proximity to retail sites;<br>Density, proportions of open space, sense of place, design innovation;<br>New Urbanist housing principles (public space, interconnected street networks, pedestrian oriented design, a mix of uses and neo-traditional architecture);<br>Neo-traditional development; | Diao and Ferreira (2010); SR (2010); Asabere (1990); SR (2016); Song and Knaap (2004); Matthews and Turnbull (2007); Tu and Eppi (1999); Buitelaar and Schilder (2017); Ahlfeldt and Mastro (2012); Bowes and Ihlanfeldt (2001); Bartholomew and Ewing (1995); Levine and Inam (2004); Nase et al. (2016); RICS (2016); Yang, Song, and Choi (2016); Cervero and Duncan (2004); Whitbread (1978) |

| | | |
|---|---|---|
| | Architectural styles in residential developments;<br>Proximity to iconic heritage buildings in residential areas;<br>Size of residential developments;<br>Presence and proximity of rail stations in the residential areas;<br>Transit-oriented development;<br>Pedestrian- and transit-oriented development;<br>Public investment in the exterior of properties;<br>Connectivity and vitality associated with building density, appropriateness of material quality and fenestration and massing in relation to the surroundings;<br>Better place-making in residential areas;<br>Commercial activity in residential areas;<br>Land-use diversity in residential areas;<br>Replacement of elevated freeways;<br>Proximity to bad neighbour uses or eyesores | |
| Influence on commercial property values | High development density, land use mix and walkability;<br>Proximity to public transportation;<br>Greater walkability;<br>External design quality;<br>Higher design quality specifications across interior, exterior and urban scales;<br>Trophy architect design;<br>Building quality (configuration and external design factors);<br>Architectural quality;<br>Architectural (aesthetic) excellence;<br>Retail design (plan layout, durability, aesthetics);<br>Urban greening, especially trees;<br>Urban greenery;<br>Aspects of quality design (connectivity, frontage continuity and variety, material quality and massing appropriateness);<br>Public art on buildings;<br>Buildings designed by signature architects | Cervero and Duncan (2002); Nase et al. (2016); Vandell and Lane (1989); Hough and Kratz (1983); Fuerst et al. (2011) |
| **Streets, public realm** | | |
| Influence on economic value | Presence of quality street space;<br>Walkability, streetscape quality, vehicle access;<br>Mixed use street environments;<br>Traditional high street qualities;<br>Public realm quality; | UN (2013); Lawlor (2013); Carmona (2015); CABE (2007); NYCDT (2012a); NYCDT (2012b); Carmona et al. (2017); CBRE (2017); SR (2016) |

| | | |
|---|---|---|
| | Bike paths, expanded walking facilities, new parks, streetscape improvements, bus transit facilities;<br>Improved accessibility and a more welcoming street environment;<br>Public realm improvements on mixed high street locations;<br>Public space improvements;<br>Redevelopment of post-war Modernist housing with street based urbanism | |
| **Regeneration** | | |
| Influence on economic development | High quality architecture;<br>Aspects of architectural design in a downturn (appearance, space and layout);<br>Masterplanned development;<br>Heritage based regeneration;<br>Heritage based designation;<br>Retention and investment in heritage buildings;<br>Low cost health based physical interventions (to encourage physical activity);<br>Well-designed buildings (that better meets occupier needs);<br>Better urban design (more attractive, accessible, legible, connected, mixed, resilient etc.);<br>Better urban design (local character, connectivity, density, mixed uses, adaptability, high quality public realm);<br>Greater permeability, compactness and mixed use;<br>Urban design types and preferences | Worpole (2000); Bell (2005); EH (2002); Ahlfeldt et al. (2012); (2013); Spencer and Winch (2002); Carmona et al. (2001); McIndoe et al. (2005); La Rosa et al. (2017); Ryan and Weber (2007) |
| **Safety and well-being** | | |
| Influence on public spending | Accessible, attractive and well-cared for greenspace;<br>Density, land use mix, availability of destinations, distance to public transport, design and neighbourhood walkability;<br>Healthy and unhealthy neighbourhoods;<br>Increased walkability;<br>Good, bright, even lighting after dark; vehicles prohibited from parking on the pavement; direct green man crossings; and pavements with no cracks and which are even;<br>Design responses focused on personal security, good street lighting, the quality of environment generally and good maintenance;<br>Compact city (over sprawl) urban structures;<br>Compact city urban structures; | Zapata-Diomedi, Herrera, and Veerman (2016); Pineo (2016); Litman (2004); Leinberger and Alfonzo (2012); Ewing and Dumbaugh (2009); Glaeser and Gottlieb (2008); CABE (2009); Zhan and Chui (2016) |

| | | |
|---|---|---|
| | Green infrastructure in urban developments;<br>Green infrastructure (including public parks);<br>Sustainable urban drainage (SuDS) and open space in relation to development;<br>Reducing crime risk through design;<br>Benefits of low impact development (LID) practices (green roofs, bioretention systems and porous pavements);<br>Poorly constructed and designed housing;<br>Bad design (the one that fails) | |

These architectural factors or place quality factors are primarily orientated towards design, whether regarding the building level or urban level. Reflecting on the research problem, these factors represent design properties that might add value to the housing directly to its market value or through other economic mechanisms. These architectural factors suggest economic intuition behind the variance of market value, which professional assessors can capture by using the market approach. Including these factors in hedonic models could be a step forward towards a universal model that is suitable for professional use. Although creating a universal model for professional use would be complicated, because usually there is no data granular enough for architectural factors inside a city. In order to solve this problem, expert valuation or computer computed rating of architectural appearance could be used.

Looking at these architectural factors from a theoretical perspective helps to understand the range of architectural factors that might have an influence on the housing market value. While architectural factors from the scientific literature on the determinants of the housing market value have a more direct influence on the property market value, the other part of architectural factors found in literature on the value that the built environment generates have positive public outcomes, which result in higher market value. A direct influence as well as indirect influence on the market value exists. The complex mechanism of value transfers between architectural factors, the built environment, public policy dimensions and a housing market value exists.

### 1.3.5. The classification of architectural factors[10]

The hierarchy of architectural factors is complex, i.e., the lower scale factors are the same ones that create higher scale factors (Figure 8). The structural theory explains that structures get unique properties compared to their elements when elements are embedded in a structure. This explains why the concept of urban design emerges. The combinations of buildings create unique urban properties. The crucial idea is that those are the same building level architectural properties that, acting together as a combination, create urban level properties.

[10] This sub-section has been quoted verbatim from the following source: Skripkiūnas, T., & Navickas, V. (2023). Architectural factors influencing a housing market value: A theoretical framework. *Real estate management and valuation, 31*(1), 25–35. doi:10.2478/remav-2023-0003

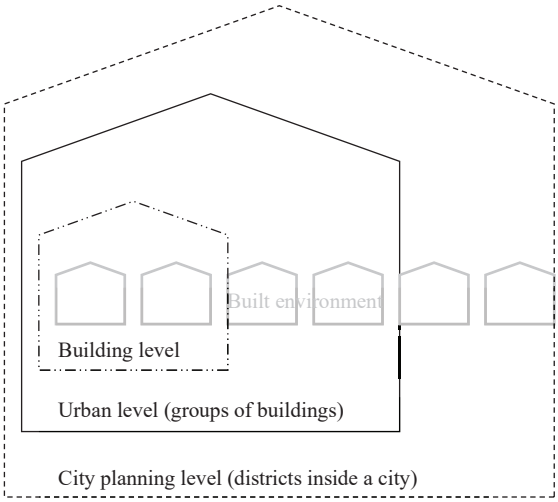



**Figure 8**. The structural hierarchy of architectural factors; source: created by the author

The visualisation of architectural factors across two dimensions is presented in Figure 9. Two main dimensions of architectural factors are identified: (1) factors spanning from building/interior/private to urban and planning/public (from bottom to top); (2) factors spanning from non-design/explained/functional (utilitarian) to design/unexplained/abstract (from left to right). A gradient or matrix of variables exists rather than strict groups. The first dimension resembles aesthetics and functionalism, both of them interactive with the design distinguished by Vandell and Lane (1989). The second dimension resembles a building (object) and urban structure (the structure object is situated in) as intrinsic and extrinsic attributes that are as well explained by Vandell and Lane (1989). Similarly, Vandell and Lane (1989) wrote that every object possesses design and non-design characteristics. Non-design characteristics are selected by consumers, and there could be numerous design configurations in order to achieve those characteristics. Those different configurations can create different amounts of value.

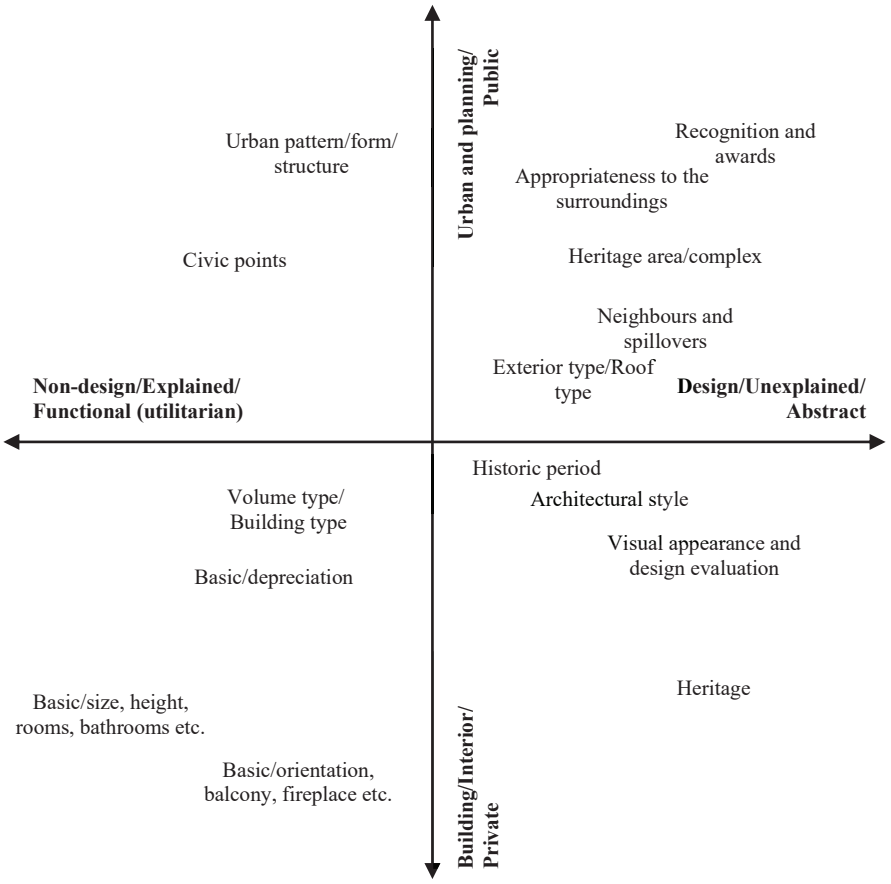



**Figure 9**. Dimensions and categories of architectural factors; source: created by the author

The concept of architectural factors is positioned between the basic hedonic properties of housing and the unexplained part of the housing market value. Furthermore, on the other dimension, the architectural factors are widely spread between market/private and non-market/public realm. Therefore, some of the variance created by the architectural factors is already captured by the hedonic models. The least explored area of architectural factors is in the upper right quarter of Figure 9, comprising design/unexplained/abstract and urban and planning/public. If market value is considered from the product perspective, this quarter is what drives market value further from the fundamentals and creates market bubbles. The problem with those unexplained urban design architectural factors is that there is no data or the fact that it is hard to measure those factors.

It is clear that not all architectural factors described in the literature review are equal in terms of scale, measurability, public or private context, aesthetic or functional priority. For example, size is so commonly used and easy to measure compared to the architectural style, which is difficult to understand and hard to identify. Moreover, size is something that comes from a client or necessity rather than architectural vision,

is not primarily in control of an architect, while architectural style is more abstract and emotionally binding. Consumers select the size of the housing object because of objective reasons and select the style because of subjective preference. The primary classification of architectural factors is suggested in Figure 10.

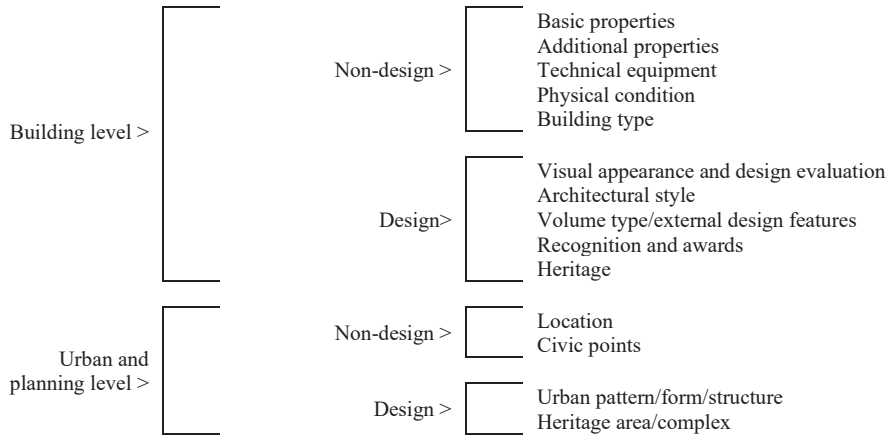



**Figure 10**. The classification of architectural factors; source: created by the author

Various approaches to housing market value exists. The market approach tries to compare similar transactions, whereas the cost approach has correction coefficients to deal with the unexplained variance. The concept of having these different approaches tries to solve the fundamental question, i.e., why buildings with similar cost, taking into account the income that they can generate, end up with different market value. The misalignment of estimated market value between different approaches indicates the existing unexplained variance. In the context of a housing market, the architectural factors and economic factors should be considered as a complex system that cannot be analysed in parts. This research looks at the overlap between the architectural factors and the housing economics. In the modern context of behavioural economics and neuromarketing, there is a need to recognise the similarities of a housing market value dynamics to other asset class price dynamics and architectural design factors to be included within the economic models.

There is a significant number of architectural factors that according to the literature review, might have an impact on the housing market value and can be used for the valuation models. However, the architectural factors are not well-defined, and the boundaries of such variables are blurred in various dimensions. This research positions those variables in the context of existing hedonic models and economic literature. At a fixed moment in time, the difference between the cost of architectural factors and their effect on the price is what creates value. Architecture, in the widest sense, works as a unique structure. The combined structural effect of the combination of individual factors creates new properties or urban and planning factors that have no additional cost, therefore creates value.

Although architectural factors are often interpreted only as the ones that are contributing to a visual or design appeal, a more systematic approach would be to classify them as a matrix of built environment properties. It is clear that specific architectural factors are of a different nature. Two orthogonal dimensions can be identified: architectural factors spanning from building/interior/private to urban and planning/public; and factors spanning from non-design/explained/functional (utilitarian) to design/unexplained/abstract. The architectural factors include well-known non-design utilitarian measures starting with size or age and ending with abstract measures of visual appearance, heritage and others.

### 1.3.6. The positioning of architecture between market value and public value[11]

*Market value (good)*. Buildings are seen as singular objects. There are lots of hedonic housing price models where buildings are market goods. In those models, the determinants of the housing market value are various attributes of buildings that have influence on the price.

Looking at the built environment as a market good, it is seen as a product with its price. Regarding the looks, various studies show that architectural quality has an impact on selling and rent prices. It was shown that in downtown Chicago, new commercial buildings that won architectural awards had higher rent levels (Hough and Kratz, 1983). Commercial buildings that were rated highly by the architects in Boston and Cambridge as well had higher rent levels (Vandell and Lane, 1989). A price premium for certain architectural styles was found in Newburyport, Massachusetts (Asabere et al., 1989) or the Netherlands. Moreover, the market value of the housing is driven by the expectations and desires; therefore, the design trends and irrational behaviour over time become apparent. Although looks, whether inside or outside, are important, nothing that is not exclusively dedicated to its owner utility directly adds up to its price. This is where architecture as an externality emerges.

*Externalities*. Buildings are seen as singular objects related to other singular objects. "An economic situation involves a consumption externality if one consumer cares directly about another agent's production or consumption" (Varian, 2006). Therefore, a consumption externality in housing is very common as building is perceived in its architectural surroundings. "Similarly, a production externality arises when the production possibilities of one firm are influenced by the choices of another firm or consumer" (Varian, 2006). Therefore, the architects are highly influenced by the site restrictions when designing a building.

There is no market for better architectural surroundings, but the housing market is highly influenced by them. Market value becomes dependent on the externalities (production and consumption of neighbouring architectural objects). "However, there are other social institutions such as the legal system, or government intervention that can 'mimic' the market mechanism to some degree and thereby achieve Pareto

[11] This sub-section has been quoted verbatim from the following source: Navickas, V., & Skripkiūnas, T. (2020). Microeconomics of architecture: between market and public. *Vadyba = Journal of management, 36*(2), 85–90.

efficiency" (Varian, 2006). The regulations and municipality administration can take this part.

With a conviction that the housing market value is highly spatially dependent, the location factors are becoming ubiquitous in hedonic price models. These may include methods to capture the distance to city focal points, spillovers of the value of other buildings or objects. There can be found a lot of research focussing on identifying house price determinants related to their location and surroundings. It is confirmed that the housing data is highly spatially dependent (Wilhelmsson, 2002). Spatial modelling was used to incorporate spillovers of house prices into the traditional hedonic model for decades (Can, 1990; Anselin, 1988; Le Sage and Pace, 2009); there is research done how to incorporate those spatial econometric models better in recent studies in Athens (Stamou et al., 2017). Spatially weighted regression or spatial econometrics are being widely used.

It is demonstrated that there are spillovers of quality design. It is important for the buildings the looks of the built environment that surrounds them. This hypothesis can be tested "by looking at the price impact of attractive neighbouring buildings" (Glaeser et al., 2018) or distance to urban focal points and their influence on the rent prices (Gat, 1998). It was shown that the houses designed by Frank Lloyd Wright has a positive effect on the prices of houses nearby (Ahlfeldt and Mastro, 2012). It is difficult to measure the quality of surroundings; however, various attempts are being pursued.

Furthermore, abandoned or poorly maintained buildings are negative externalities. Similarly to various examples of pollution, the owners of such properties should face social cost of their actions. The concept of network externalities and two-sided markets is important in city planning. Schools, day care centres, kindergartens, shops, restaurants and other social infrastructure are undersupplied in new housing areas, because their market decisions may not meet the needs of the residents.

There would definitely be incentives to internalize such externalities acquiring public values of quality surroundings. "If the actions of one affect the other, then they can make higher profits together by coordinating their behaviour than by each going alone" (Varian, 2006). However, the separation of public and private space in the city is so deeply embedded in people consciousness and subconscious that the main structure of city space cannot be internalized (there are other reasons for this, but this is not in the scope of this study). This is where the architecture as a public value (good) emerges.

*Public value (good)*. Buildings are seen as complexes and structures. Not all externalities can be internalized in the district or city. "As soon as there are more than two economic agents involved things become much more difficult" (Varian, 2006). Although different locations can have different levels of architectural quality, which might result in local externalities, the quality of architectural surroundings is such a widely available externality that everyone in the city must consume the same amount of it; therefore, it is becoming a public good.

Many public goods are provided by the government. Public spaces in the cities, e.g., streets, squares, parks, sidewalks, are all the same for everyone to use. Local municipalities are supposed to cover the need for architectural elements that serve the

need for public goods. As municipalities are not able to fully satisfy the need for quality architectural surroundings, this should be accompanied by building owners. However, the tragedy of the commons or free riding is becoming more apparent. The players in the housing market are neglecting the need for social infrastructure and quality public spaces, therefore resulting in lower overall value of their developments (as the demand for such developments is related to non-market or public goods in that area).

Architectural design, as a public good or widely available externality, has impact on many economic activities: it is a huge externality for the housing market, it is a tool for attracting consumers and producers to the city, advertising quality of life. There are studies that link tourism sector with the architectural surroundings "that enhances the special local characteristics of place through unique design qualities that tourists are attracted to consume" (Scerri et al., 2019), resulting in consumption of space and economic activity in particular areas of the city (Aranburu et al., 2016). The quality of built environment cuts deeply into the mental maps of the cities.

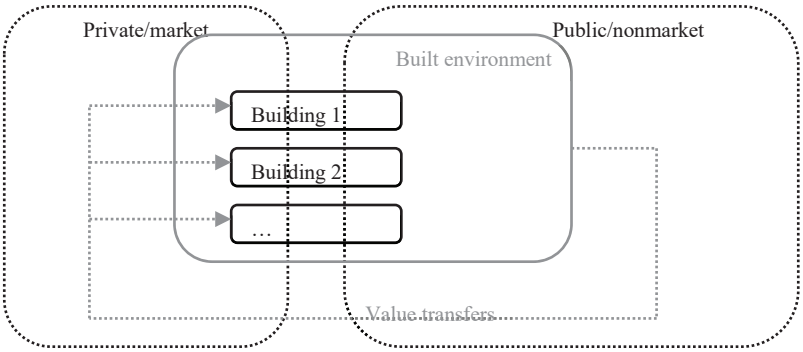



**Figure 11**. The position of buildings between market and public; source: created by the author

Understanding the types of value that the built environment can generate, a conclusion can be drawn that some types of architectural factors are market goods while others are public or non-market goods (Figure 11). At the same time, considering buildings, they are externalities to the other objects. The network externalities may be detected as well. The internalization of architectural externalities is limited due to the nature of city public space. Therefore, architecture, as a public good, is a significant factor of economic activity in the city, as it can be shown in the examples of tourism sector.

*Conclusions*. The main concepts that have been outlined in the previous sub-sections are the following:

1. The housing market value includes fundamental/explained/rational/market part (architectural non-design factors) and unexplained/irrational/non-market part (architectural design factors).
2. Multiple dimensions of a housing market value exist: volatility over time, variance across space, shift/differences between segments (fixed effects of segments) and other. The variance across space is no less significant than the

volatility over time, which brings the concept of spatial bubbles. This dissertation focuses on the variance across space only in the following research.

3. Two major dimensions of architectural factors exist. This creates four categories of architectural factors: (1) building non-design (explained/rational/market/private), (2) urban and planning non-design (explained/rational/non-market/public), (3) building design (unexplained/irrational/market/private), (4) urban and planning design (unexplained/irrational/non-market/public). The determinants of the housing market value and value architecture that the built environment generates are split between the private value and public value.

All these core components from the previous sub-sections are integrated into the theoretical model of the influence of architectural factors on the housing market value in the next section.

## 2. THE MODEL AND METHODOLOGY OF EMPIRICAL RESEARCH ABOUT THE INFLUENCE OF ARCHITECTURAL FACTORS ON THE HOUSING MARKET VALUE

### 2.1. The theoretical model of the influence of architectural factors on the housing market value[12]

The mechanism of value transfers is presented in Figure 12. The interrelationships between architecture and the built environment are described in Figure 5 (see sub-section 1.3.2.). Two main directions, i.e., 'value in exchange' (building architectural factors) and 'value in use' (urban and planning architectural factors), can be taken from the built environment perspective. 'Value in use' is divided into five types of value that a built environment can generate. Although, 'value in use' and 'use value' may be inappropriate to use together, 'value in use' was chosen to refer to the research done by Nase et al. (2015). There is as well a distinction between the market and non-market goods in Figure 12. Around the concept of 'market value', there is an area defined by 'market' that as well takes some part of the other 'values in use'. The majority of social, environmental and cultural values fall into the area defined by 'non-market'. However, these values are later transferred to 'market value' through modifiers. The idea of modifiers is described as well in Figure 7 (see sub-section 1.3.3.).

The link between the 'built environment' and 'market value', as an equivalent in money, works both ways, as elements of built environments can be bought or sold. However, the determination process of 'market value' goes through a series of values that a built environment can generate, relying on the idea of translation of various types of value to 'value in exchange' or 'market value'.

[12] The 1st and 2nd paragraphs of this sub-section have been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., Tanas, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: A methodological framework. *Journal of international studies, 13*(4), 38–53. doi:10.14254/2071-8330.2020/13-4/3

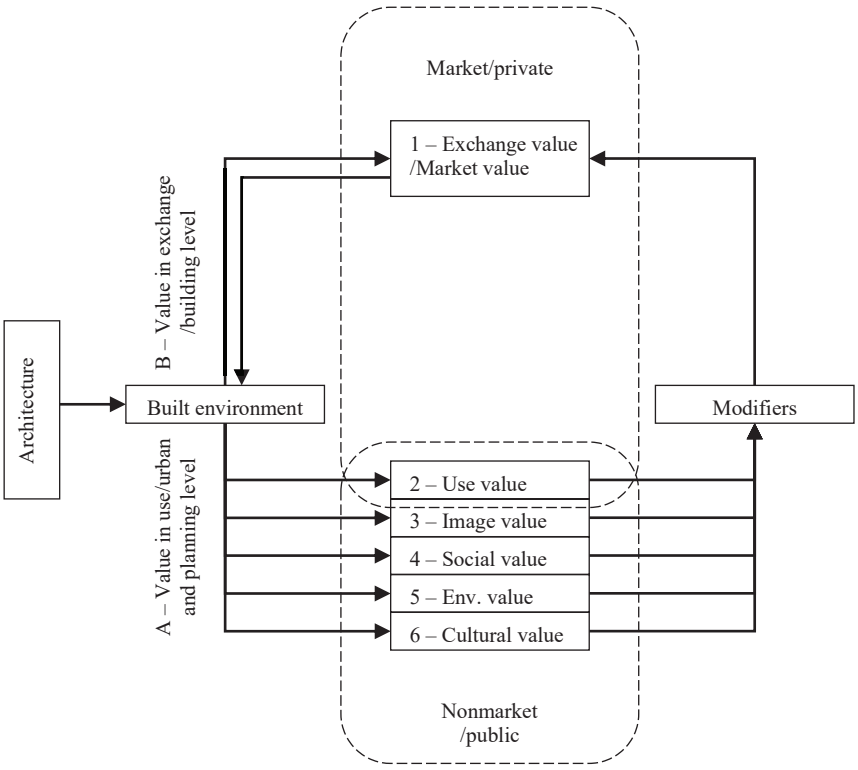



**Figure 12**. The theoretical framework of transfers of private and public value between the built environment and housing market value; source: created by the author

The architectural factors have influence through various economic mechanisms: volatility over time, variance across space, shift/difference between segments. The economic mechanism of architectural factors influencing housing market value is presented in a theoretical model (Figure 13). Adding architectural factors to the model would presumably increase the accuracy of the housing market value. The architectural factors of a housing market value are divided into two groups: (1) explained (non-design) and (2) unexplained (design) factors. Both of those groups are further divided into two smaller groups: (1) building and (2) urban and planning factors. This results in 4 categories of architectural factors: (1) building non-design, (2) urban non-design, (3) building design, (4) urban and planning design.

Explained variance can be explained by non-design factors. Unexplained variance could be explained by design factors. Better building level architectural factors would directly influence the housing market value. Better urban and planning level architectural factors would create public value (outcomes) that is further translated to the housing market value.

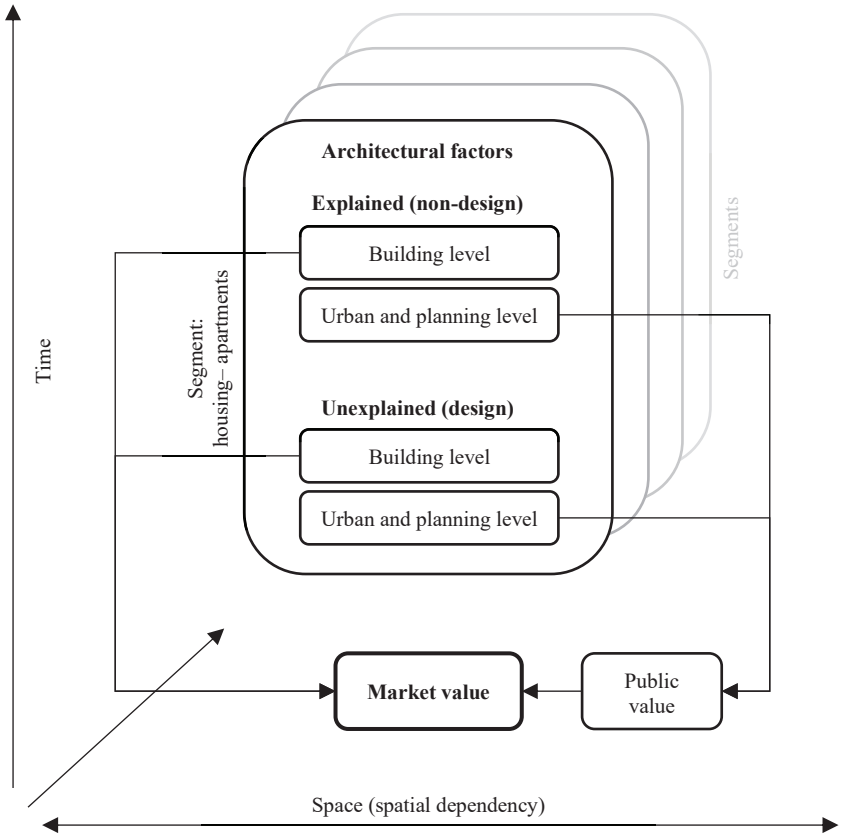



**Figure 13**. The theoretical model of the influence of architectural factors on the housing market value; source: created by the author

A multidimensional and complex system of architectural factors influencing a housing market value exists. It involves spatial dependency, time, segments, architectural factors, explained and unexplained variance. Understanding this system is crucial for the housing development to succeed.

The selected segment for the empirical research is *housing/apartments*. The selected mechanism is *spatial dependency*. The time is fixed. Spatial dependency is rather ambiguous. It is the framework that the architectural factors are embedded in. Spatial dependency is as well an object of reverse causality. Firstly, urban structures are created and defined by the buildings, then spatial dependency becomes an architectural factor itself in many research studies through the public value created by the urban and planning factors.

## 2.2. The strategy of empirical research

In order to address the aim of this research, which is to evaluate the influence of architectural factors on the housing market value, three core strategic assumptions are made:

(1) *Spatial dimension or dependency*. While it is common to observe the housing market value volatility over time, the novelty of this study emerges from the research into the spatial dimension of apartment market value variance. This variance across space is observed at a city scale. The time is fixed. This research looks at the phenomena of spatial bubbles in the housing market, building on the existing hedonic models.

(2) *Design factors*. A hypothesis was raised that the unexplained variance of a housing market value can be attributed to the architectural design factors. Point of interest, i.e., design factors, is the unexplained variance across space. As the building level design factors are hard to measure, the research focuses on the significance of urban and planning level design factors, and building level design factors are left in the residuals. In a broader context, the research tries to answer the question whether the architectural quality of the surroundings has influence on the housing market value, and if yes, by how much.

(3) *A city scale*. Market value is observed inside a city. This approach adds another dimension to the phenomena of the housing market spatial dependency and bubbles. This research employs almost reverse process compared to what CPI or HPI are doing while aggregating the prices of heterogeneous architectural objects to reflect the city or country price. This research tries to extract how the individuals or a group of individuals differentiate across space inside the selected city dataset.

*Model, context and variables.* This research implies that the architectural factors are influencing the housing market value. A housing market value is a dependent variable. The architectural factors are independent variables. The asking price on the developers and real estate websites is used for apartment market value data. It is sufficient because the apartment prices are only compared to each other; therefore, there is no interest in the absolute level of market value. A *ceteris paribus* assumption is used for other factors, such as time, consumer preferences or irrationality, supply and demand trends, microeconomic and macroeconomic factors, as well as cost.

The scope and limitations of the empirical research. This is done to get as close as possible to the *ceteris paribus* assumption:

1. The complexity of market value variance over time is eliminated. Data is collected at the fixed moment in time to eliminate the temporal effects.
2. The absolute level of market value is not in the scope of this research, only the relative market value comparing apartments to each other is used.
3. The complexity of different functions of architecture is restricted to the housing, only apartment market value is used for the empirical research.
4. The complexity of design factors is restricted to urban and planning design factors.
5. Although in Lithuanian case, it is common to buy an apartment with a piece of land that it is built on, the land prices are not considered in the context of this research.

6. The masterplan of the city of Vilnius is used to extract urban design and planning factors. It captures the current situation with forward-looking perspective.

There is a wide range of architectural factors as indicated in the theoretical background (see sub-section 1.3.5.). The architectural factors can be assigned to two major groups in this research: control factors (non-design) and design factors. This research focuses on the influence of design factors on the housing market value. First, the coefficients of control factors are calculated to eliminate the effects of those control factors on the apartment market value. Then, there is a possibility to test the relationship between the residual variance of apartment market value and urban and planning design factors. After eliminating urban and planning level design factors, building level design factors would be left in the residuals. The conclusions are available to be made about the structure of a housing market value.

In order to answer the research question, such hypotheses have been raised:

1. Non-design control architectural factors (floor, size_m2…) have significant influence on the apartment market value (price_m2) (1st stage).
2. Urban and planning design factors have significant influence on the apartment market value (price_m2) (2nd stage).

There are some assumptions made to make the empirical research possible. The construction costs are undisclosed in most cases; thus, the assumption is made that there is the same number of good buildings with low construction costs and bad buildings with high construction costs. In other words, the construction cost is the same for good and bad buildings, which is not necessarily the case, but on average, presumably, it is true. Building level architectural quality is similar in this sense. The selected data is presumably on average of all the same architectural quality. Final residuals would still contain the variance of building level design variables.

## 2.3. The design of empirical research[13]

The housing, unlike many other consumer products, is very heterogeneous and one can argue that not a single object is identical to the other; therefore, it is difficult to construct models, as most economic models assume the homogeneity of the objects of interest. The first step of removing the heterogeneity was the selection of context for the empirical research. The selected data for the empirical research was narrowed down to the newly constructed, partly finished apartments in the urban environment in Vilnius. This is a significant portion of the housing market and the one that gets great attention because of being one of the biggest investments in consumer lifetime.

A regression analysis in various forms was used to isolate the unexplained variance and identify the spatial bubbles. The main idea was to remove the explained variance (non-design) and leave the unexplained variance (design), residuals. In the

[13] The 1st and 2nd paragraphs of this sub-section have been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

end, the result was presented as the residual variance of apartment market value inside a city. Because of the unexplained nature, these residuals were treated as spatial bubbles. The economic intuition behind these methods goes in parallel with the theory of the housing fundamentals and the unexplained or irrational nature of the housing market bubbles.

*The identification strategy of empirical research*. The research is done in two stages, both of which have two branches (options) (Figure 14). The empirical research include: (1) collecting apartment market value data, (2) controlling for non-design variables, (3) modifying market value data resulting in residual variance, spatial bubbles, (4) testing the significance of design factors, (5) making conclusions about residual variance that includes building design factors. The empirical research is done in stages to have better control over interim results and the ability to compare the results of different branches of the empirical research (for better control and critical review over the intermediate findings).

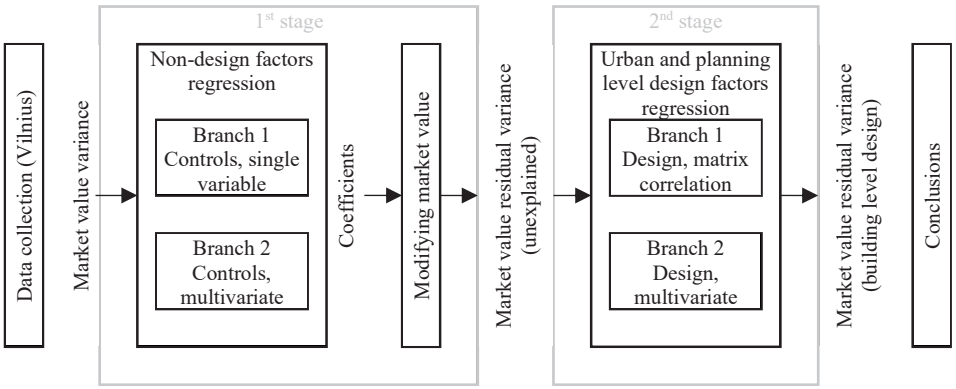



**Figure 14**. The design of empirical research; source: created by the author

The aim of the first stage is to get the residual variance of apartment market value after removing the effects of the control factors (explained, non-design). Although these control factors are architectural variables as well, these are non-design factors that are not in control of an architect as described in the theoretical background (see sub-section 1.3.5.). Two different approaches, two branches (options), are used to extract the coefficients of control variables: (1) first approach is manual method using subsets of dataset No. 1 (developers) and singular regression; (2) second approach is multivariate regression of dataset No. 1 (developers). These computed coefficients are used to modify the broader dataset No. 2 (ntzemelapis.lt) and identify the spatial bubbles. Dataset No. 2 (ntzemelapis.lt) is modified as if all control factors were the same for every apartment in the city. The desired result of the first part, residual variance (unexplained, design) of apartment market value, spatial bubbles inside a city, is described in theoretical background (see sub-section 1.2.2.).

The aim of the second stage is to test the influence of design factors on the apartment market value. Urban and planning design factors are used in the regression that the building design factors would be left in the residuals. The second stage starts with residual variance after controlling for non-design factors in the first stage. This unexplained variance should include the influence of building level design and urban and planning level design factors. Dataset No. 2 (ntzemelapis.lt) and Vilnius master plan dataset are used in this stage. First branch: the correlation between the apartment market value residual variance and the selected urban and planning design variables is checked. Second branch: the regression is used to test the hypothesis of urban and planning design factors influencing the apartment market value. Building design variables are left in the residuals at the end. The conclusions about building design factors are made looking at the coefficient of determination and residuals.

### 2.4. The empirical model of the influence of architectural factors on the housing market value[14]

This creates a methodological basis for creating a housing market value empirical model: market value is equal to the control variables for non-design (building level non-design and urban and planning level non-design) and unexplained variance (building level design and urban and planning level design) and the residuals (Figure 15). The concept of this model comes from the apartment market value that is being cost adjusted by the design factors and other unknown factors, such as consumer irrationality. Moreover, the cost is dependent on the non-design factors and partly on the building design factors. In the context of newly constructed, partly finished apartments at a fixed moment in time:

$$P_i = C_i + X1_i + X2_i + \varepsilon_i;$$

$P_i$ – market value, $C_i$ – cost, $X1_i$ – building level design factors, $X2_i$ – urban and planning level design factors, $\varepsilon_i$ – residuals, market correction for other unknown factors, such as consumer irrationality.

$$C_i = constant\ + A1_i + A2_i + X1'_i;$$

$C_i$ – cost, $constant$ – fixed part, $A1_i$ – building level non-design factors, $A2_i$ – urban and planning level non-design factors, $X1'_i$ – partly building level design factors.

[14] The 1st paragraph of this sub-section has been quoted verbatim from the following source: Skripkiūnas, T., & Navickas, V. (2023). Architectural factors influencing a housing market value: A theoretical framework. *Real estate management and valuation, 31*(1), 25–35. doi:10.2478/remav-2023-0003

Therefore:

$$P_i = constant + A1_i + A2_i + X1_i + X2_i + \varepsilon_i;$$

$P_i$ – market value, $constant$ – fixed part, $A1_i$ – controls for building level non-design factors, $A2_i$ – controls for urban and planning level non-design factors, $X1_i$ – building level design factors, $X2_i$ – urban and planning level design factors.

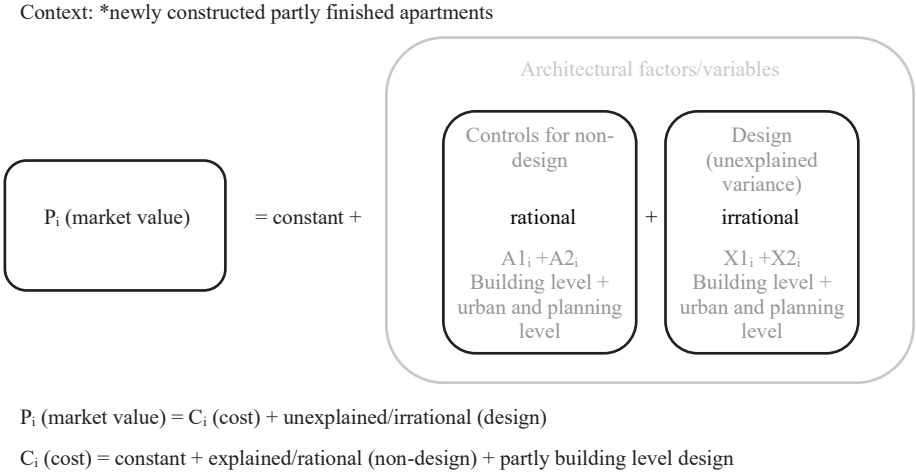



**Figure 15**. The empirical model of the influence of architectural factors on the housing market value; source: created by the author

The main idea behind these formulas is to control for non-design factors and add design factors to hedonic housing market value models. The empirical model of the influence of architectural factors on the housing market value shows four categories of architectural factors to be used in the empirical research. The final results are presented in a similar format as well.

### 2.5. The selected data and research methods[15]

Two datasets of market value and data for urban and planning factors are used:

1.1. Dataset No. 1 (developers).
1.2. Dataset No. 2 (ntzemelapis.lt).
2. Data No. 3 (masterplan of Vilnius, 2021).

The data is collected in 2021 April–May.

The dataset No. 1 is collected from the developers who are selling newly constructed apartments in Vilnius. It has apartments from 9 different projects in

[15] The 4th paragraph of this sub-section has been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

Vilnius and a lot of homogeneous apartments inside those projects. The dataset No. 2 is collected from ntzemelapis.lt. It has listed advertisements of newly constructed apartments in Vilnius from various sellers. The apartments are more scattered in various locations and more heterogeneous. The dataset No. 1 is majorly used to calculate the coefficients of control (non-design) factors; the dataset No. 2 is used for the further research. The dataset No. 1 (developers) appears to be better in order to extract the control coefficients, because that dataset contains way more homogeneous apartments that are more usual for the economic models. The dataset No. 2 (ntzemelapis.lt) is better for the value map because the apartments are more scattered in different locations.

The following variables are included in the datasets:

(1) *Market value*, the market value of an apartment price and price_m2.

(2) *Coordinates*, the spatial reference where the apartment is situated in Vilnius.

(3) *Control variables*, the building level and urban and planning level non-design factors: floor, floor_max, size_m2, rooms, centre_km, civic_km, civic_num. The effect of these variables needs to be eliminated for further research. A location can be hard to distinguish from a neighbourhood or urban design and planning because urban design and planning create neighbourhoods that are fixed in a certain location. However, a location is treated as explained non-design variable, it defines the variance of position but none of the architectural properties. Other non-design factors are inevitable to avoid when designing a building, for example, differently sized apartments need to be arranged in floors.

(4) *Urban and planning design variables*, architectural form and function, as such, are selected to represent the design variables. The urban form is the core ingredient of architecture; therefore, its mathematical interpretation might mean something. There is no need to know which form is good or bad, but only the numbers are important that show the variance of architectural form. Therefore, it will not be possible to say whether it is good or bad architecture influencing the housing market value, but only that if the change in urban form has influence on the housing market value. A hypothesis is raised that urban form has influence on the use, image, social, cultural and environmental values and, therefore, apartment market value. This data might not have intuitive or interpretive meaning; however, it will show the change of urban form. Various layers of urban form are selected: urban pattern, function, building intensity, building density, building height.

**Table 4.** Descriptive statistics of the selected dataset No. 1 (developers); source: created by the author

**Dataset No. 1 (developers) descriptive statistics**

| Statistic | N | Mean | St. Dev. | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| price_m2 | 522 | 2,471.01 | 544.25 | 1,729.36 | 2,036.42 | 2,724.69 | 4,500.00 |
| price | 522 | 131,994.00 | 51,218.23 | 67,000 | 95,000 | 148,075 | 375,100 |
| size_m2 | 522 | 53.13 | 14.04 | 24.54 | 42.95 | 59.27 | 106.60 |
| rooms | 522 | 2.46 | 0.70 | 1 | 2 | 3 | 4 |
| floor | 522 | 3.37 | 1.93 | 1 | 2 | 4 | 9 |
| balcony_m2 | 522 | 8.20 | 6.67 | 1.58 | 4.35 | 8.00 | 60.05 |
| centre_km | 522 | 3.99 | 2.08 | 0.52 | 1.70 | 6.08 | 7.13 |
| civic_km | 522 | 4.80 | 1.80 | 2.39 | 2.76 | 6.88 | 7.74 |
| civic_num | 522 | 25.37 | 20.57 | 4 | 4 | 49 | 56 |

**Table 5.** Descriptive statistics of the selected dataset No. 2 (ntzemelapis.lt); source: created by the author

**Dataset No. 2 (ntzemelapis.lt) descriptivce statistics**

| Statistic | N | Mean | St. Dev. | Min | Pctl(25) | Pctl(75) | Max |
|---|---|---|---|---|---|---|---|
| price_m2 | 576 | 2,531.20 | 912.41 | 1,149.48 | 1,949.71 | 2,960.44 | 9,032.26 |
| price | 576 | 158,771.30 | 129,762.30 | 38,450 | 93,850 | 164,454.8 | 963,000 |
| size_m2 | 576 | 60.48 | 30.69 | 14.49 | 41.89 | 70.56 | 321.21 |
| rooms | 576 | 2.55 | 0.99 | 1 | 2 | 3 | 5 |
| floor | 576 | 3.23 | 2.23 | 1 | 2 | 4 | 16 |
| floor_max | 576 | 6.09 | 3.48 | 1 | 4 | 7 | 29 |
| centre_km | 576 | 3.89 | 2.19 | 0.50 | 2.21 | 5.12 | 13.54 |
| civic_km | 576 | 4.57 | 1.93 | 2.14 | 2.90 | 5.73 | 13.27 |
| civic_num | 576 | 29.75 | 20.51 | 0 | 7 | 48 | 57 |

*The selected data for the first stage*. In order to apply the theory of bubble formation to a city and its districts microenvironment, granular data is needed. Two datasets were used for this research. The dataset No. 1 consists of new apartments of the selected projects that have been published in the real estate developers' websites for sale in Vilnius. There are 522 observations. These datasets were used to get the coefficients for controls, such as floor and size of the apartment, because it is possible to select numerous identical apartments with just one parameter varying in these datasets. The dataset No. 2 consists of apartments that have been listed on the website for sale by brokers and individuals. There are 576 observations. The dataset No. 2 includes spatially referenced apartments from the biggest city and capital of Lithuania, i.e., Vilnius. The descriptive statistics of the selected datasets are presented in Table 4 and Table 5.

*The selected data for the second stage*. The residual variance of the first stage is regressed on the design variables (intensity, density, height_max, commerce). The masterplan of the city of Vilnius is used. The drawings/images of the masterplan of Vilnius are converted to the matrices representing urban and planning design factors. The images are easy to convert into the matrix format for the further research. They

capture the current situation with forward-looking perspective. Asset market, in general, is looking forward, and the housing market is naturally sensitive to the long-term perspective; thus, it makes sense that the housing market value is influenced by the forward-looking factors.

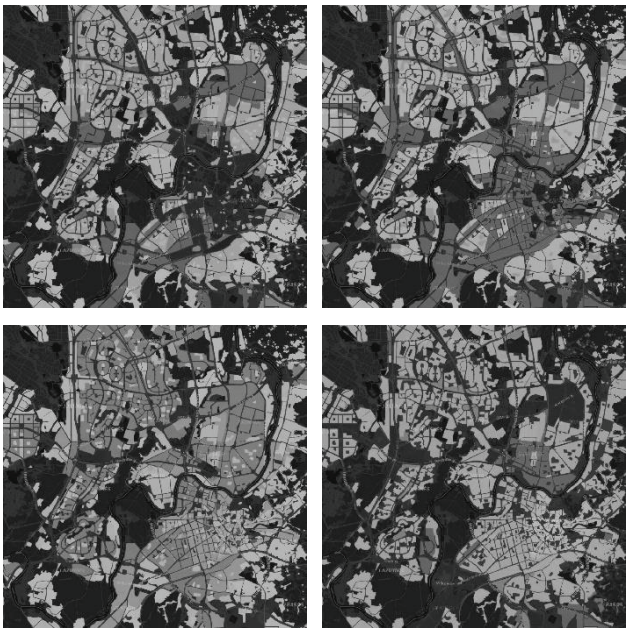


**Figure 16**. Images of urban and planning design factors: (1) intensity, (2) density, (3) height_max and (4) commerce; source: Masterplan of Vilnius (2021), figure modified by the author

*Normality of the selected data*. The normality of the distribution of the dependent variable (ln(price_m2)) in dataset No. 2 is checked (Figure 17). The histogram shows slight asymmetry that is acceptable because there is more variation in the upper market value quarters. Natural logarithm transformation is used for the dependent variable to improve the normality of the data, make the outliers less extreme and, finally, improve the interpretability of regression model results. In general, the normality of the distribution of the dependent variable is sufficient. The normality of independent variables is checked to be sufficient for the empirical research as well.

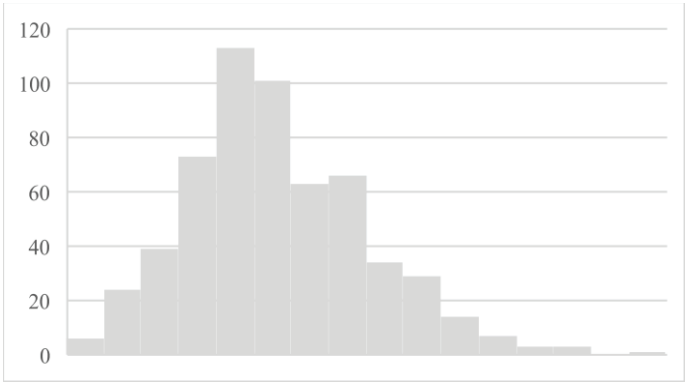



**Figure 17**. Histogram of the selected data (NT žemėlapis, 2021); source: created by the author

*Research methods*. Single variable regression, multivariate regression, spatial analysis, interpolation, correlation analysis methods are used in the empirical research. Single variable regression is used to extract the control coefficients in the first stage. Multivariate regression is used for the same task. The results are compared. The spatial interpolation is important for the identification of the apartment market value spatial bubbles. It is used to estimate the apartment market value at unknown points by using points with known values. This solves the problem of apartment market value data being not evenly spread across the city. The statistical surface of the apartment market value is created, which could be tested against the statistical surface of urban design and planning variables. The correlation analysis and multivariate regression is used to test the significance of urban design and planning factors in the second stage.

Tools/software that were used include R, QGIS, Excel: single variable regression – Excel; market value spatial data analysis – R, QGIS; multivariate regression, correlation – R; urban design and planning factors analysis – R, QGIS; visualisation, spatial diagrams – R, QGIS.

## 3. THE RESULTS OF EMPIRICAL RESEARCH ON THE INFLUENCE OF ARCHITECTURAL FACTORS ON THE HOUSING MARKET VALUE

### 3.1. Controlling for non-design architectural factors

#### 3.1.1. The single variable regression of non-design factors[16]

In the 1st branch of the 1st stage, the linear regression was used for apartment non-design control variables. The regression was the main method to eliminate the effect of control variables because unexplained variance that was left was important for the research. In the 1st branch, only identical apartments with varying floor or size are selected (subsets of dataset No. 1 (developers)). Identical apartments from the same project with the same layout and orientation one on top of each other are selected for the influence of floor number on the price per sq. m research. The apartments of different sizes from the same project and floor were selected for the influence of size on price per sq. m research. The apartments with significantly larger balconies or terraces were eliminated from the influence of floor on price per sq. m research. The apartments with significantly different orientation in the same floor were eliminated from the influence of size on price per sq. m research. This approach as well involved careful inspection of the floor plans to prove the robustness of the results.

Every step was done to measure the relative price; therefore, the market value of the 2nd floor, 45 sq. m size apartment was selected as a reference point in the results. The diagrams show the relative market value of apartments compared to the reference while changing the selected control variables, such as floor or size (Figure 18 and Figure 19). The 2nd floor was selected as a reference because the 1st floor is highly dependent on the neighbourhoods. While in most cases, it trades with a discount compared to the 2nd floor, sometimes, especially further away from the city centre, it has a premium for possible terrace space or easy access; therefore, the market value of the 1st floor apartments can be unstable and is not a good reference. Rooms variable was dropped because it was found to be redundant and less accurate compared to the size; therefore, the size was used. In the 1st stage, the 1st branch apartments were compared within their project; therefore, there was no need to control for location, neighbourhood properties, urban and planning design and building design.

[16] The 1st and 2nd paragraphs of this sub-section have been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

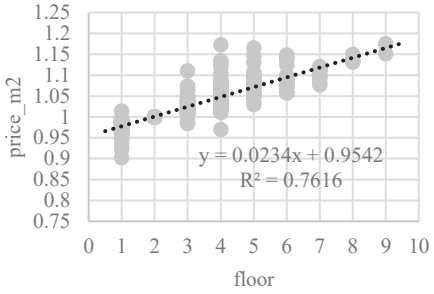



**Figure 18**. The influence of floor number on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author

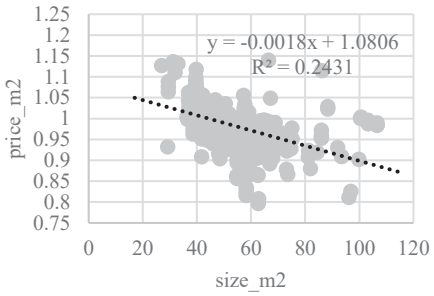



**Figure 19.** The influence of apartment size on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author

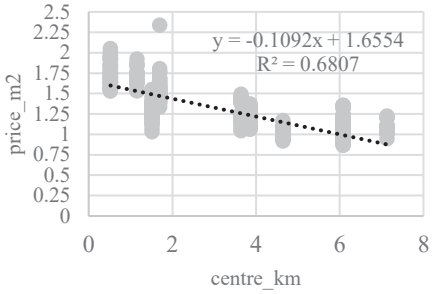



**Figure 20.** The influence of distance to the city centre on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author

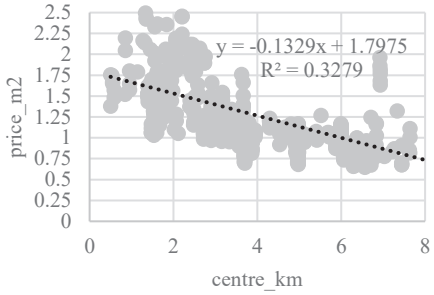



**Figure 21.** The influence of distance to the city centre on the price per sq. m of the selected apartments in Vilnius, dataset No. 2 (ntzemelapis.lt); source: created by the author

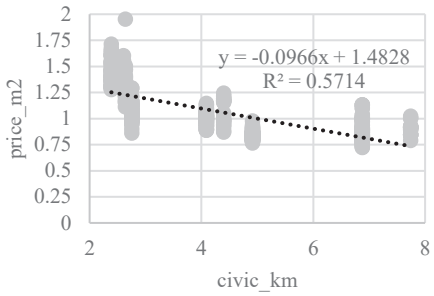



**Figure 22.** The influence of distance to the civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author

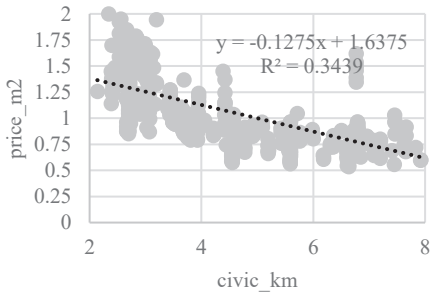



**Figure 23.** The influence of distance to the civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 2 (ntzemelapis.lt); source: created by the author

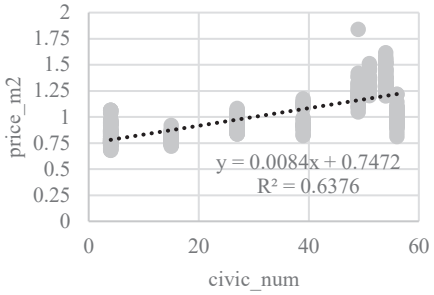



**Figure 24.** The influence of number of civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 1 (developers); source: created by the author

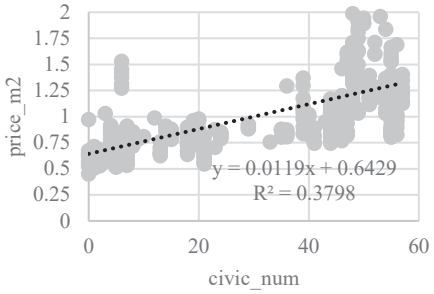



**Figure 25.** The influence of number of civic points on the price per sq. m of the selected apartments in Vilnius, dataset No. 2 (ntzemelapis.lt); source: created by the author

Another part of the first stage is to control for urban and planning non-design (location) inside a city. This is done by using distance to the centre or number of civic points around (Figure 20 – Figure 25). The location is assumed to be a non-design factor because it defines the variance of position but none of the architectural properties and is something that developers are given to deal with while creating the built environment. There will be apartments in different locations regardless of what buyers prefer. The influence of urban and planning non-design factors on the apartment market value is presented by using both datasets to check the consistency of the results.

### 3.1.2. The multivariate regression of non-design factors

In the 2nd branch of the 1st stage, full dataset No. 1 (developers) is used. The aim of the 2nd branch is the same as of the first branch; however, in this branch, multivariate regression is run to determine the control coefficients instead of examining them by using the subsets of homogeneous apartments with changing only one factor. Fixed effects are added to the control for differences between different projects (urban and planning factors). The multivariate regression results are presented in Table 6. Dependent variable is a natural logarithm of price per square

metre (ln(price_m2)), independent variables: floor, size, balcony size, size_rooms residuals and project fixed effects. All coefficients are found to be significant. The assumptions and conditions for regression were checked.

**Table 6.** The influence of non-design control factors on the price per sq. m multivariate regression results; source: created by the author

| | *Dependent variable:* | | |
|---|---|---|---|
| | ln(price_m2) | | |
| | (1) | (2) | (3) |
| floor | 0.029*** | 0.029*** | 0.029*** |
| | (0.002) | (0.001) | (0.001) |
| size_m2 | -0.002*** | -0.003*** | -0.003*** |
| | (0.0002) | (0.0002) | (0.0002) |
| balcony_m2 | | 0.004*** | 0.004*** |
| | | (0.0004) | (0.0004) |
| size_rooms_resid | | | -0.001** |
| | | | (0.0005) |
| citus_misko_ardai | 0.041*** | 0.006 | 0.011 |
| | (0.015) | (0.014) | (0.015) |
| eika_baltas_lapas | 0.237*** | 0.213*** | 0.212*** |
| | (0.014) | (0.013) | (0.013) |
| galio_group_jomanto_parkas | -0.248*** | -0.239*** | -0.243*** |
| | (0.011) | (0.010) | (0.010) |
| hanner_verkiu_sodas | -0.103*** | -0.100*** | -0.106*** |
| | (0.012) | (0.011) | (0.011) |
| homa_giluzio_rivjera | -0.109*** | -0.108*** | -0.105*** |
| | (0.016) | (0.015) | (0.015) |
| homa_lazdyneliu_vingis | -0.180*** | -0.190*** | -0.192*** |
| | (0.010) | (0.009) | (0.009) |
| homa_vytenio4 | 0.305*** | 0.309*** | 0.307*** |
| | (0.016) | (0.014) | (0.014) |
| yit_matau_vilniu_iii | 0.326*** | 0.317*** | 0.323*** |
| | (0.012) | (0.011) | (0.011) |
| yit_naujasis_skansenas | | | |
| Constant | 7.861*** | 7.862*** | 7.854*** |
| | (0.015) | (0.014) | (0.014) |
| Observations | 522 | 522 | 522 |
| $R^2$ | 0.913 | 0.928 | 0.929 |
| Adjusted $R^2$ | 0.911 | 0.927 | 0.927 |
| Residual Std. Error | 0.061 (df = 511) | 0.055 (df = 510) | 0.055 (df = 509) |
| F Statistic | 536.854*** (df = 10; 511) | 598.605*** (df = 11; 510) | 555.129*** (df = 12; 509) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

There is a problem of collinearity in the selected variables. In general, size, price, rooms and price_m2 are interconnected: price, size and price_m2 are mathematical functions of each other; size and rooms co-move to some extent. Although the bigger size means more rooms, rooms might have some extra explanatory power because some apartments of the same size have different number of rooms. In order to deal with the collinearity between rooms and size, the approach was selected to regress one of the correlated predictor variables on the other. This is done by running a regression analysis, using one of the independent variables to predict the other independent variable. Then, the residuals of that regression are used as a new variable that is not correlated with the other (size_rooms_resid).

Multivariate regression of the 1st stage results show that building level non-design factors have on average 15% effect (up to 26%) on a housing market value (inside the project), and urban and planning factors (both non-design and design) have on average 17% effect (up to 32%) on a housing market value (between the projects in Vilnius, fixed effects of different projects/locations). The selected variables (floor, size_m2, balcony, size_rooms_resid) and project dummy variables are statistically significant.

**Table 7.** The comparison of coefficients of two branches of the first stage; source: created by the author

| | Single variable regression (developers) | Single variable regression (ntzemelapis.lt) | Multivariate regression (developers) |
|---|---|---|---|
| floor | 0.023 | - | 0.029 |
| size_m2 | -0.002 | - | -0.003 |
| balcony_m2 | - | - | 0.004 |
| size_rooms_resid | - | - | -0.001 |
| centre_km | -0.109 | -0.133 | - |
| civic_km | -0.097 | -0.128 | - |
| civic_num | 0.008 | 0.012 | - |

*Comparison of two branches*. The homogeneity of apartments in the dataset No. 1 (developers) allows to create subsets of data for single variable regression. This is not available in the heterogeneous dataset No. 2 (ntzemelapis.lt). In the multivariate regression, civic points and distance to the centre are captured by fixed effects of individual projects. The coefficients are consistent between the two branches (Table 7).

At the end of the 1st stage, the coefficients of explained non-design variables from both branches are used to modify the apartment market value data (price per sq. m) of the dataset No. 2 (ntzemelapis.lt). A market value of the 2nd floor, 45 sq. m size apartment with 30 civic points within 4 km distance was selected as a reference for removing building level non-design and urban and planning level non-design factors. The variable of civic points co-move with distance to the centre variable; therefore, the civic points were used. Civic points variable captures a location that is relative to the biggest concentration of the civic points.

Thus, 10 x 10 km area of Vilnius was selected (Figure 26). The residual variance (statistical surface) diagram is created from spatially referenced modified apartment market value data (Figure 27). The inverse distance weighted (IDW) interpolation is used to get the statistical surface diagram of the city of Vilnius. The coefficient of variance of apartment market value unexplained residual variance across the space in Vilnius is 16%.


**Figure 26.** The map of Vilnius; source: maps.lt (2021), figure modified by the author

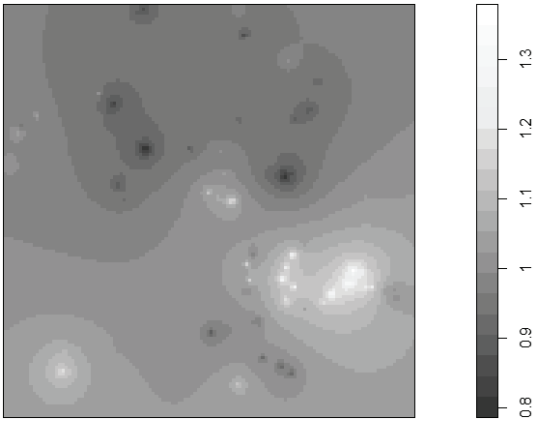



**Figure 27.** The statistical surface diagram of unexplained residual variance of apartment market value in Vilnius; source: created by the author

The regression model shows that higher floor has a positive effect on the price per sq. m; higher apartment size has a negative effect on the price per sq. m; bigger balcony has a positive effect on the price per sq. m; smaller number of rooms has a negative effect on the price per sq. m. It could be said that people want to live on higher floors with bigger balconies, and the price per sq. m of apartments with less floor area is higher. Moreover, if the number of rooms is the same, the apartment with smaller floor area has a higher market value.

The 1st stage results support the hypothesis:

(1) Non-design control architectural factors (floor, size_m2…) have significant influence on the apartment market value (price_m2) (1st stage).

### 3.2. Measuring the influence of design factors on the housing market value

#### 3.2.1. The correlation between market value and urban and planning design factors

In the 1st branch of the 2nd stage, the correlation analysis between the unexplained residual variance of apartment market value in Vilnius and the selected urban and planning design factors is tested. Both images, market value and urban factors, are converted to matrices and compared. Matrix correlation and similarity indexes are presented in Figure 28 – Figure 31.

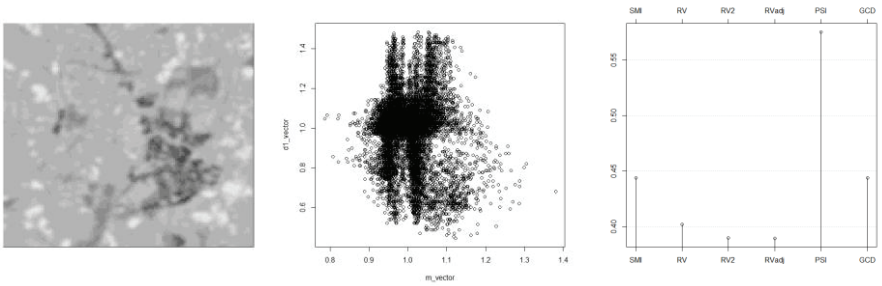



**Figure 28**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – intensity; source: created by the author

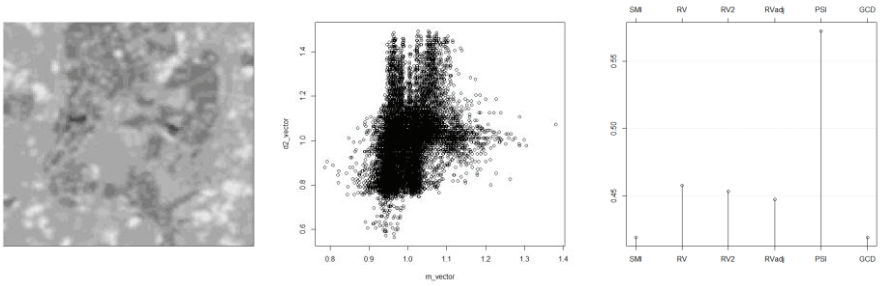



**Figure 29**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – height; source: created by the author

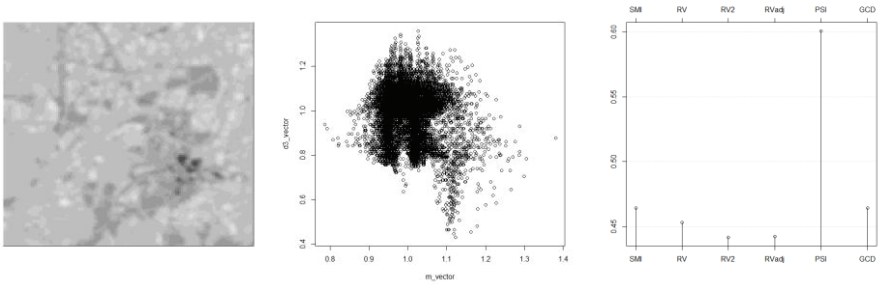



**Figure 30**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – density; source: created by the author

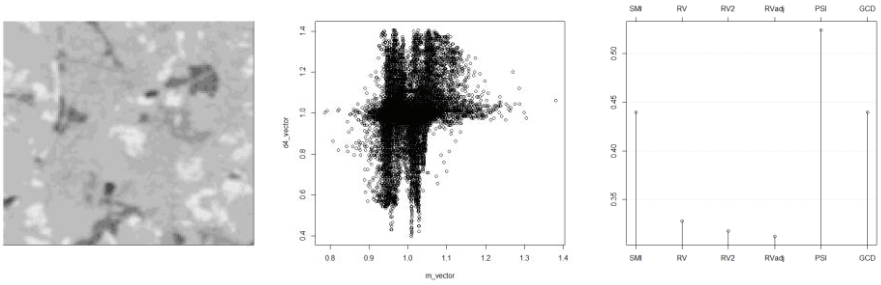



**Figure 31**. The analysis of the correlation between the unexplained residual variance of apartment market value in Vilnius and urban and planning design factor – commerce; source: created by the author

The used indexes include: SMI – a similarity index for comparing coupled matrices (Indahl et al., 2018); RV – a unifying tool for linear multivariate statistical methods, the RV-coefficient (Robert and Escoufier, 1976); RV2 – matrix correlations for high-dimensional data, the modified RV-coefficient (Smilde et al., 2009); adjusted RV – exploratory analysis of multiple omics datasets using the adjusted RV coefficient (Mayer et al., 2011); PSI – studies in the robustness of multidimensional scaling, Procrustes statistics (Sibson, 1978); Coxhead – measuring the relationship between two sets of variables (Coxhead, 1974). The correlation between the unexplained residual variance of apartment market value in Vilnius and the selected urban and planning design factors exists; however, it is weak. The correlation coefficients vary between values of 0.31 and 0.60.

### 3.2.2. The multivariate regression of urban and planning design factors

In the 2nd branch of the 2nd stage, the modified market value data (residual variance) multivariate regression is run. The dependent variables are urban and planning design factors. The summary of regression results is presented in Table 8.

**Table 8.** The influence of design factors on the price per sq. m multivariate regression results; source: created by the author

| | *Dependent variable:* | | |
|---|---|---|---|
| | ln(price_m2_modified) | | |
| | (1) | (2) | (3) |
| intensity | -1.174*** | | |
| | (0.091) | | |
| intensity_density_resid | | -0.874*** | -0.855*** |
| | | (0.120) | (0.117) |
| density | | -1.413*** | -1.705*** |
| | | (0.115) | (0.124) |
| height_max | 1.010*** | 1.036*** | 0.721*** |
| | (0.099) | (0.098) | (0.111) |
| commerce | | | 0.559*** |
| | | | (0.102) |
| Constant | 7.966*** | 8.169*** | 8.208*** |
| | (0.094) | (0.113) | (0.110) |
| Observations | 576 | 576 | 576 |
| $R^2$ | 0.250 | 0.268 | 0.305 |
| Adjusted $R^2$ | 0.247 | 0.264 | 0.300 |
| Residual Std. Error | 0.291 (df = 573) | 0.287 (df = 572) | 0.280 (df = 571) |
| F Statistic | 95.507*** (df = 2; 573) | 69.763*** (df = 3; 572) | 62.551*** (df = 4; 571) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

The intensity co-moves with density; therefore, intensity_density_resid is used. Density means how densely the urban environment is built up. Intensity means the ratio of the sum of the total area of the premises of all buildings to the area of the land parcel. Intensity_desity_resid shows the intensity factor that is not captured by the density. Heigh_max means the maximum allowed building height. Commerce means the maximum allowed size of commerce premises showing the amount of public usage of the built environment. Three models are presented. All four factors (intensity_desnity_resid, density, height_max, commerce) in the final model are found to be significant.

There is a relationship between the market value and urban design and planning variables. Urban design and planning factors are able to explain 30% of the unexplained residual variance or 9% of the overall apartment market value variance across space. The regression model shows that bigger intensity has a negative effect on the price per sq. m; bigger density as well has a negative effect on the price per sq. m; however, bigger building height has a positive effect on the price per sq. m; the

amount of commerce premises has a positive effect on the price per sq. m. It could be said that people are attracted to buy apartments in higher floors and have more commerce nearby; however, they want to live in a less densely built-up neighbourhood.

The 2nd stage results support the hypothesis:

(2) Urban and planning design factors have significant influence on the apartment market value (price_m2) (2nd stage).

### 3.3. The final results and discussion[17]

A significant amount of unexplained spatial variance was found inside a city. This phenomenon deserves more attention in the housing market value determination research. This as well adds another dimension to the housing market bubbles that can be seen as the spatial market segmentation from the local supply and demand perspective. While supply, demand and resulting submarkets are the core elements of the housing market value determination process, the resulting submarkets depend on the unexplained factors, such as urban and planning design and building design.

The key aspect of the identification of spatial bubbles in the housing market is the fact that supply and demand are not global but rather local. Because of the nature of the real estate, spatially arranged submarkets appear in microenvironments. Economics construct the market value models in relation to the supply and demand, however, the reasons behind lower or higher demand raise more questions and go beyond economics. The research suggests merging the supply and demand models with architecture, representing the best use of existing space and resources. This holistic approach deepens the understanding of the structure of the housing market value determination process.

The position of urban and planning level factors and building level factors in the hedonic models has been reconsidered. This raises a question about the position of architectural factors within these hedonic models. While all these factors are architectural ones, urban and planning level non-design (location) and building level non-design are explained; urban and planning level design (neighbourhood) and building level design are unexplained. While these unexplained factors are hard to measure, this raises a discussion of the extent of hedonic properties that can be relied on while determining the housing market value.

After controlling for non-design factors, up to 16% of the apartment market value unexplained variance across space is observed; therefore, the spatial bubbles in a housing market in Vilnius are identified. The causal nature of this variance is yet to be confirmed; however, while applying hedonic properties to eliminate individual heterogeneity, it is obvious that these apartments differ in their architectural appearance and surroundings. The next stage of empirical research was to test the

[17] The 1st, 2nd and 3rd paragraphs of this sub-section have been quoted verbatim from the following source: Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13

influence of the design factors. The significance of urban and planning design factors is confirmed, contributing to 9% and leaving the building design factors in residuals. The average overall composition of the apartment market value factors are as follows: constant – 64%, building non-design – 6%, urban and planning non-design – 14%, building design (+error term) – 7%, urban and planning design – 9% (Figure 32).

The decomposition of the influence of architectural factors on the housing market value (Figure 32) shows how much variance across the space of a housing market value is left after eliminating each group of architectural factors. This calculation is based on the coefficient of variation and decomposed coefficients of determination of both regressions. It means that initially, there is 36% variation in a housing market value data. The constant part resembles the fixed part of a housing market value. The constant part together with non-design factors resemble the fundamental part of a housing market value, leaving 16% of unexplained variance across space for design factors and error term.

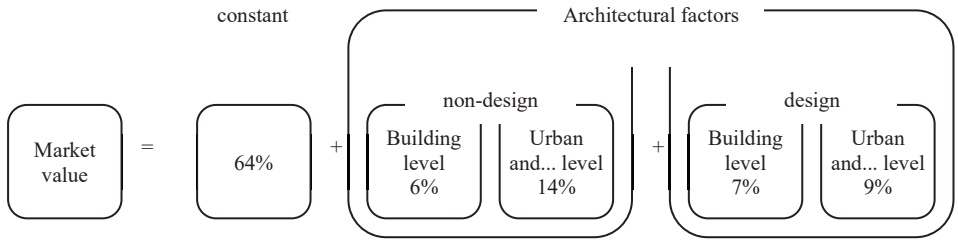



**Figure 32**. The decomposition of influence of architectural factors on the housing market value; source: created by the author

Further on, there will be presented a comparison with literature, discussion and a comparison to the results of other studies.

(1) Irrational variance of a housing market value includes a study by Glindro et al. (2011); deviation of country-level house prices from fundamental values (7–10%); deviation of city-level house prices from their fundamentals (1–12%); the same concept at country and city scale in Asia; the research by Tupenaite et al. (2017). Rational indicators (q = 0.8019) consist of economic indicators (q = 0.4939 of decision criteria) and market indicators (q = 0.3080 of decision criteria); irrational indicators (q = 0.1981). Glindro et al. (2011) used a mean-reversion process, serial correlation and various regression techniques, similar to this dissertation, to address the housing price dynamics in Asia. Panel data was used for the period of 1993–2006. One of the objectives was to identify the evidence of housing bubbles, i.e., the situation when housing market value is higher than the fundamental value. The approach in the study by Tupenaite et al. (2017) was to use analytic hierarchy process (AHP) method, which is based on the expert survey. The main objective was to rank the determinants of the Lithuanian housing market fluctuations for the period of 2005–2015.

(2) *Price premiums for the architectural styles*. Many studies have linked the architectural factors to the value of buildings, and they mostly found a positive relation between good design and the housing market value. The research by Asabere et al. (1989) found a 14–28% price premium for certain architectural styles in Newburyport, Massachusetts, the USA for the period of 1983–1985. The research by Buitelaar and Schilder (2017) measured the 5–15% price premium of the neo-traditional architectural style of buildings in the Netherlands for the period of 1995–2014. Both studies used hedonic price models, multivariate regression. Although the study by Asabere et al. (1989) was focusing on historic architecture, it clearly showed that there is a link between architectural appearance and the housing market value.

(3) *Price premium for awarded architects (architectural offices)*. The research by Hough and Kratz (1983) assessed the influence of architectural factors on the office rent prices. New commercial buildings that won architectural awards had a 22% rent premium. Vandell and Lane (1989) evaluated the office buildings in Boston and Cambridge to understand the effect of good architecture on their construction costs, rent levels and vacancy rates, i.e., 5–22%. They found that the better is the design quality of the office buildings, the higher is the rent. Fuerst et al. (2011) proved that the offices designed by famous architects had higher rent levels than those whose designer was less famous (5–7% rent, 17% price premium). In the study by Vandell and Lane (1989), the quality was accessed by a panel of architects, correlation and regression analysis. Hough and Kratz (1983) employed the same methods, although used available data for the architectural quality assessment and recognised offices as historic landmarks or awarded by the Chicago American Institute of Architects jury.

Similar to this dissertation, other studies used hedonic models and panel data multivariate regression analysis. However, a number of other studies used expert valuation to assess the architectural quality. Glindro et al. (2011) as well used stages in the empirical research design, confirming that this might be a good strategy for decomposing the housing market value and calculating the fundamental and irrational parts. Glindro et al. (2011) conclude that there is much to be done on the research on house price dynamics. It is said that national aggregated housing market value hides the variance of market value across cities or market segments. Therefore, city level data would be needed to identify the local market bubbles. This dissertation builds on this idea although not in the city level but in a district or building level. The variance across space is more sensitive to the final consumer because aggregated volatility over time is global at the city scale, while variance across space inside a city is local and leaves the customer with choices inside a city.

The proportion of unexplained or irrational part of the market value in the literature is 5–28% price/rent premium (average 13.8%), which is similar to the results of this dissertation, i.e., 16%. The average percent in literature is lower because all those studies were focusing on the effect of some more narrow group of specific factors. It is very difficult to separate the urban and planning non-design factors (location) from the urban and planning design factors, because urban and planning design is inspired and created by the properties of different locations inside a city. This area requires more theoretical and empirical research.

Future research possibilities:

1. Add volatility over time; time dimension could be added looking at previously sold spatially referenced apartment market value; this would allow to test whether the spatial bubbles change over time or how quickly;
2. Add other cities;
3. Add customer segments; a step further could be the market segmentation from buyer's perspective, meaning that buyers with some characteristics are looking for certain apartment characteristics, which might suggest that the price bubbles can be created by buyers, not architectural properties;
4. Add other types of architecture (functions);
5. Possible qualitative research to check the robustness of the results; expert survey, focus group; public value of spatial bubbles; expert valuation of what drives spatial bubbles.

## CONCLUSIONS

1. The main concepts of the first section of the theoretical background of the research about the housing market value volatility over time included the explained fundamentals and unexplained (residual) volatility/variance, rational and irrational factors (non-design and design factors). These concepts form the theoretical background for this research. There are explained/rational and unexplained/irrational parts of the housing market value. It is common in literature that the housing market value consists of the fundamental part and the unexplained parts. These can be as well referred to as rational and irrational parts. Such structure of a housing market value reflects on the broader economic context: traditional economics can explain the fundamental part while other fields of science need to be included in order to explain the irrational part.
2. The same concepts, as seen when looking at the housing market value volatility over time, are applied for variance across space at a fixed moment in time in the second section of the theoretical part. In general, various dimensions of a housing market value could be revealed: variance across space, volatility over time, shift between segments. This research focuses on the variance across space (spatial dependency), which is naturally linked to the changes of the built environment across space. Architectural factors are embedded in the built environment that naturally resembles the variance across space of a housing market value. There are different cycles of the housing market value in different locations that result into unexplained variance across the space and, therefore, spatial bubbles. Learning from the behavioural economics, other fields of science should be explored to understand this unexplained variance better. A hypothesis is raised that the architectural factors could explain both the rational and irrational parts of the housing market value.
3. Two major dimensions of architectural factors exist. This creates four categories of architectural variables: (1) building level non-design (explained/rational/market/private), (2) urban and planning level non-design (explained/rational/non-market/public), (3) building level design (unexplained/irrational/market/private), (4) urban and planning level design (unexplained/irrational/non-market/public). There is no clear line between the non-design (control) and design factors: there is a gradual transition between these factors. Therefore, the challenge to control for heterogeneity, location and neighbourhood and extract the design factors exists. This research focuses on the architectural factors in general and on the architectural design factors specifically. Architecture is not only the design of a building, it as well includes non-design factors and urban and planning level factors. This helps to structure the factors in hedonic models of a housing market value research.
4. The determinants of the housing market value and value that the built environment generates are split between private value (building level) and public value (urban and planning level). The significant part of a housing market value goes round the non-market field and then modifies the housing market value. This is a social dilemma situation because neighbourhoods are created by

the groups of buildings, not single ones, and those are the same buildings that succeed at the end if acting in favour of a group. Therefore, urban and planning factors are significant in the housing market value determination process. This stays in line with a belief that location is the key in the housing market value determination process, and the location is actually created by the urban and planning factors. However, the interesting part is that urban and planning level factors are collectively created by building level architectural factors.

5. The theoretical model of the influence of architectural factors on the housing market value includes all previously mentioned concepts (explained and unexplained parts, four categories of architectural factors, time, space, segments, market value and public value) in one model. This creates a framework for the empirical research model. As it is derived from the theoretical part, the composition of a housing market value consists of the constant part, controls and the unexplained part. Theoretically and methodically, the constant part represents the fundamental part of the housing market value. The controls can be further decomposed into building level non-design factors and urban and planning level non-design factors. The unexplained part can be further decomposed into building level design factors and urban and planning level design factors. Two stages and calculations of the residual variance are used for the empirical research to decompose the housing market value.
6. The first stage results support the hypothesis that non-design control architectural factors (floor, size_m2 etc.) have significant influence on the apartment market value (price_m2). The regression model shows that higher floor has a positive effect on the price per sq. m; higher apartment size has a negative effect on the price per sq. m; bigger balcony has a positive effect on the price per sq. m; a smaller number of rooms has a negative effect on the price per sq. m. It could be said that people want to live on higher floors with bigger balconies, and the price per sq. m of apartments with less floor area is higher. Moreover, if the number of rooms is the same, the apartment with smaller floor area has a higher market value. These results are in line with literature and economic intuition. While the significance of these non-design control architectural factors is important, the contribution of the first stage is to eliminate the effects of these factors, which results in unexplained residual housing market value variance across space.
7. The second stage results support the hypothesis that the urban and planning design factors have significant influence on the apartment market value (price_m2). The regression model shows that bigger intensity has a negative effect on the price per sq. m; bigger density as well has a negative effect on the price per sq. m; however, bigger building height has a positive effect on the price per sq. m; the amount of commerce premises has a positive effect on the price per sq. m. It could be said that people are attracted to buy apartments on higher floors and have more commerce nearby; however, they want to live in a less densely built up neighbourhood. These results are in line with the economic intuition. The contribution of the second stage is to confirm the significance of

the influence of urban and planning level design factors on the housing market value.

8. The final results suggest that after controlling for non-design factors, up to 16% of the apartment market value unexplained variance across space is observed. It is obvious that these apartments differ in their architectural appearance and surroundings. The significance of urban and planning level design factors is confirmed, contributing to 9% and leaving the building level design factors in residuals. The average overall composition of apartment market value factors: constant (cost) – 64%, building level non-design – 6%, urban and planning non-design – 14%, building level design (+error term) – 7%, urban and planning design – 9%. Although Vilnius was selected for the empirical research, the model can be applied to any other city. This dissertation creates future research possibilities to further confirm the robustness over time and results of such composition of a housing and any other segment of the real estate market value.

## SUMMARY

### Tyrimo temos aktualumas

Architektūrinės aplinkos tyrimai yra gana fragmentiški tarp architektūros profesionalų, ekonomistų, geografų ir kitų sričių specialistų. Tačiau socialinių, kultūrinių, ekonominių ir aplinkosauginių vertybių kontekste architektūrinė aplinka užima pagrindinę vietą. Architektūra, kaip menas ir mokslas, formuojantis architektūrinę aplinką, šia prasme tampa gana įtakinga. Iškeliama hipotezė, kad architektūriniai veiksniai gali turėti savo vaidmenį darant įtaką būsto rinkos vertei.

Būstas, kaip pagrindinė architektūrinės aplinkos dalis, šiais laikais gali būti vertinamas lygiagrečiai su įmonių akcijomis, prekėmis ar kitu spekuliaciniu turtu. Nors apskritai nekilnojamasis turtas yra antra pagal dydį turto klasė pasaulyje, būsto rinka kai kuriose šalyse, ypač Baltijos šalyse, gali būti didesnė už visą akcijų rinkos vertę. Baltijos šalyse negrąžintų būsto paskolų namų ūkiams suma 2018 m. siekė 19,0 mlrd. eurų (Hypostat, 2019), o listinguojamų įmonių rinkos kapitalizacija siekė 6,7 mlrd. eurų (Nasdaq, 2020). Tai rodo, kad būsto rinka apima didžiulę dalį mūsų turto kaip vartojimo ar investicinė prekė.

Aptariami būsto rinkos vertės svyravimai laikui bėgant ir dispersija erdvėje, siekiant sukurti teorinę bazę, leidžiančią suprasti būsto rinkos vertės dinamiką ir architektūros padėtį būsto rinkos vertės dinamikoje. Būsto rinkos vertės mikrodeterminantai dažniausiai stebimi fiksuotu laiku arba trumpuoju laikotarpiu, stengiantis išskirti svarbiausius rinkos vertę lemiančius veiksnius. Pokyčių laike vertinimas sukelia dar daugiau komplikacijų. Nors buvo sukurti įvairūs būsto rinkos svyravimų ir dispersijos modeliai, esminis klausimas, kas lemia būsto rinkos vertę, vis dar yra savotiškai apleistas.

Būsto rinkoje yra daug nepaaiškinamų svyravimų ir dispersijos erdvėje. Mokantis iš elgsenos ekonomikos, didžioji dalis šių svyravimų ir dispersijos gali būti siejami su nepaaiškintais ar iracionaliais veiksniais. Galima kritikuoti, kad dėmesys skiriamas paaiškintiems, racionaliems, piniginiams (rinkos) ar ne dizaino nekilnojamojo turto vertinimo aspektams, neįtraukiant nepaaiškintų iracionalių ar dizaino nekilnojamojo turto savybių.

Architektūros ir architektūrinių veiksnių sąvoka ekonomikoje nėra įprastai vartojama. Literatūroje ji turi prieštaringą reikšmę, todėl siūlomas platesnis architektūros apibrėžimas, apimantis visos architektūrinės aplinkos projektavimą nuo urbanistinio ir planavimo makrolygio iki pastatų mikrolygio. Taip pat architektūra ir architektūrinė aplinka šiame tyrime turi skirtingas reikšmes: architektūrinė aplinka reiškia fizinius architektūros objektus (ne tik pastatus, bet gatves, tiltus, šaligatvius, kraštovaizdžio statinius, taip pat nedidelio mastelio objektus), o architektūros sąvoka vartojama tų objektų dizainui išreikšti.

Daugelyje tyrimų pripažįstama architektūrinių veiksnių įtaka būsto rinkos vertei, tačiau aiškaus atsakymo apie šios įtakos mastą nėra. Yra atliekami hedoninės regresijos modelių tyrimai, kuriais siekiama integruoti architektūrinius veiksnius, kad būtų galima geriau prognozuoti būsto rinkos vertę. Tai apima erdvinės priklausomybės, architektūros ir urbanistikos veiksnių ar stiliaus ir jų įtakos būsto rinkos vertei tyrimus. Nors daugumoje tyrimų daugiausia dėmesio skiriama

svyravimams laikui bėgant, o architektūriniai veiksniai pridedami kaip kontroliniai kintamieji, kad būtų galima spręsti pastatų heterogeniškumo problemą, nėra sisteminės apžvalgos ir teorinio pagrindo tyrimams vien tik apie architektūrinių veiksnių įtaką, įskaitant vertės perdavimą tarp architektūrinės aplinkos, jos ne rinkos ar viešos vertės ir būsto rinkos vertės. Šio tyrimo tikslas – užpildyti tyrimų spragas tarp būsto rinkos vertės svyravimų laikui bėgant, dispersijos erdvėje (skirtingi ciklai skirtingose vietose) ir būsto rinkos vertę lemiančių veiksnių tyrimų. Pagrindinis indėlis – būsto rinkos vertės dispersijos erdvėje tyrimai.

Apskritai, architektūrinių veiksnių plačiąja prasme įtaka nekilnojamojo turto ekonomikai yra neišsamiai ištirta. Pagrindinė šio tyrimo idėja – ištirti architektūros vertę ir tai, kaip ji perkeliama į nekilnojamojo turto rinkos vertę, todėl naujai statomų pastatų pridėtinė vertė arba esamų pastatų kapitalinė vertė yra didesnė. Šiame kontekste į architektūrinius veiksnius galima pažvelgti kaip į neatsiejamą nekilnojamojo turto ekonomikos dalį, ekonomistai galėtų gauti kitą analizės, vertinimo ir prognozavimo įrankį, o architektūros profesionalai galėtų pasinaudoti naujausiais ekonomikos pasiekimais.

**Tyrimo problema**

Kaip architektūriniai veiksniai veikia būsto rinkos vertės erdvinę priklausomybę?

**Tyrimo objektas**

Būsto rinkos vertę lemiantys architektūriniai veiksniai.

**Tyrimo tikslas**

Įvertinti architektūrinių veiksnių įtaką būsto rinkos vertei.

**Tyrimo uždaviniai**

1. Apibrėžti būsto rinkos vertės svyravimų laikui bėgant ir dispersijos erdvėje dimensijas bei identifikuoti erdvinius burbulus.
2. Nustatyti architektūrinių veiksnių sampratą nekilnojamojo turto ekonomikos kontekste ir suklasifikuoti tuos architektūrinius veiksnius.
3. Sukurti architektūrinių veiksnių įtakos būsto rinkai teorinę bazę.
4. Sukurti ir patikrinti architektūrinių veiksnių įtakos būsto rinkos vertei vertinimo modelį ir empirinio tyrimo metodiką.

**Tyrimo problemos ištirtumo lygis**

Architektūriniai veiksniai literatūroje naudojami saikingai. Galima išskirti penkias pagrindines sritis, kur tyrimuose naudojami architektūriniai veiksniai: (1) erdvinė priklausomybė; (2) miestų ir pastatų dizaino kokybės veiksniai; (3) paveldo aspektai; (4) tvarumo aspektai; (5) viešoji architektūros vertė. Atrinkti tyrimai parodo tų veiksnių reikšmę.

(1) *Erdvinė priklausomybė, vertės išsiliejimai, išoriniai veiksniai*. Erdvinio poveikio problemos buvo iš dalies ignoruojamos atliekant nekilnojamojo turto analizę. Tačiau nekilnojamojo turto duomenys labai priklauso nuo erdvės ar vietos.

Pastaraisiais dešimtmečiais erdvinė ekonometrija buvo naudojama siekiant įvertinti kaimynystės dinamiką ir būsto vertės išsiliejimus tradiciniuose hedoniniuose modeliuose (Anselin, 1988; Can, 1990; Le Sage, 1998; 2009; Wilhelmsson, 2002; 2004). Buvo išbandyti ir kiti erdviniai ekonometriniai metodai, pavyzdžiui, atstumai iki miesto traukos taškų (Gat, 1998; Gong ir kt., 2016). Naujausiuose mokslo darbuose, kuriuose lyginami skirtingi erdviniai ekonometriniai metodai, bandoma ištirti, kaip geriau integruoti tuos erdvinius ekonometrinius modelius (Stamou ir kt., 2017). Tyrimai parodė, kad Franko Lloydo Wrighto (garsaus amerikiečių architekto) suprojektuoti namai teigiamai veikia šalia esančių namų kainas (Ahlfeldt ir Mastro, 2012). Patrauklių kaimyninių pastatų poveikis kainai taip pat buvo užfiksuotas naudojant kompiuterinio matymo techniką (Glaeser ir kt., 2018). Šios studijos rodo, kad miesto aplinkoje esantys pastatai turi įtakos architektūrinės aplinkos vertinimui.

(2) *Miesto ir pastatų projektavimo kokybės veiksniai*. Daugelis tyrimų bandė įtraukti kokybinius veiksnius arba ekspertų vertinimus į hedoninės regresijos modelius. Vienas iš ankstyviausių Hough ir Kratzo tyrimų (1983) įvertino architektūrinių veiksnių įtaką biuro nuomos kainoms Čikagos centre. Naujiems komerciniams pastatams, laimėjusiems architektūros apdovanojimus, buvo apskaičiuota 22 % nuomos priemoka. Vandell ir Lane (1989) taip pat nustatė, kad kuo geresnė biurų pastatų architektūrinė kokybė, tuo didesnė nuomos kaina. Jie apklausė architektus architektūros kokybei įvertinti. Po to sekė Asabere ir kt. (1989), suradę kainos priemoką tam tikriems architektūros stiliams. Fuerstas ir kt. (2011) įrodė, kad žinomų architektų projektuotų biurų nuomos kainos buvo didesnės. Įvairūs Belfasto miesto centre esančių butų dizaino kokybės aspektai buvo įvertinti taikant ir išplečiant hedoninį modelį, įtraukiant pastato lygio ir miesto lygio kokybinius veiksnius (Nase ir kt., 2016). Atliktas neotradicinio architektūros stiliaus poveikio būsto rinkos vertei matavimo tyrimas (Buitelaar ir Schilder, 2017). Visi šie tyrimai dažniausiai nustatė teigiamą ryšį tarp gero architektūrinio dizaino ir nekilnojamojo turto rinkos vertės.

(3) *Paveldo aspektai*. Architektūrą žmonės suvokia per mūsų sąmonę ir atmintį; todėl mūsų kolektyvinė atmintis įprasmina vietas, o tai keičia nekilnojamojo turto vertinimą. Kainos priemoka buvo nustatyta pastatams, esantiems paveldo sąrašuose, pastatams, esantiems kaimyniniuose sklypuose, ir pastatams, esantiems kultūros paveldo ar istorinių vietovių teritorijose (Lazrak ir kt., 2014). Tas pats pastebėta ir tiriant istorinius Niujorko rajonus (Been ir kt., 2014). Neseniai atliktame Rudoko ir kt. (2019 m.) tyrime nurodyta, kad žymius saugomus pastatus išlaikyti buvo brangiau, todėl jų nuomos kainos buvo mažesnės, tačiau jie veikia kaip teigiamas išorinis poveikis kaimyniniams pastatams. Daugeliu atvejų buvo nustatyta architektūros paveldo aspektų įtaka nekilnojamojo turto rinkos vertei, ypač kalbant apie naujus pastatus greta saugomų pastatų ir istorinių vietovių.

(4) *Tvarumo aspektai*. Egzistuoja poreikis įvertinti architektūrinių veiksnių įtaką namų tvarumui. Architektūrinis dizainas integruoja daugybę sprendimų pastato projekte, įskaitant orientaciją, langų išdėstymą, erdvės konfigūraciją ir apdailos medžiagų pasirinkimą (Fadaei, 2015). Geras dizainas gali pritraukti klientų tvariems namams, todėl investuotojams į tvarius namus tai didina kainų priemokas. Žmonės žino, kad, pirkdami tinkamai pasaulio šalių atžvilgiu orientuotą namą, gali sutaupyti 25 % energijos sąskaitų (Rashkin, 2010). Miesto kvartalų urbanistinė forma turi įtakos

energijos suvartojimui (Ewing ir Rong, 2008; Ratti ir kt., 2005; Chen ir kt., 2011; Lee ir Lee, 2014) ir mobilumui mieste (Zhou ir kt., 2013 m.; Nakamura ir Hayashi, 2013). Miesto dizainas ir kraštovaizdžio dizainas turi įtakos mikroklimatui (Bowler ir kt., 2010; Ko ir Radke, 2014; Jamei ir kt., 2016), oro taršai ir triukšmui (Honold ir kt., 2012). Paprastai daug architektūrinių sprendimų gali padėti pasiekti tvarumo tikslus nekilnojamojo turto ekonomikoje.

(5) *Viešoji architektūros vertė*. Architektūra kaip ne rinkos ar viešoji gėrybė. Kalbant apie architektūrą kaip miesto viešąją gėrybę, galima suvokti vertę jos gyventojams ir turizmui. Scerri ir kt. (2019) pastebėjo, kad ypatingos vietos ypatybės yra užfiksuotos ir sustiprintos architektūriniais veiksniais, o turistus traukia unikalios skirtingų vietų dizaino savybės. Tai paverčia architektūrą išoriniu veiksniu arba viešąja gėrybe, kuri labai prisideda prie ekonominės aktyvumo mieste. Šiam aktyvumui didelę įtaką daro architektūros orientyrų, viešųjų erdvių ir miesto urbanistinės struktūros pozicionavimas (Aranburu ir kt., 2016). Mieste egzistuoja numanoma architektūrinio dizaino rinka. Aplinkos kokybė gali turėti įtakos renkantis, kur gyventi, dirbti ir leisti laisvalaikį (Champ ir kt., 2017). Kalbant apie architektūrinius veiksnius, mes tiesiogiai neperkame architektūrinės kokybės ar, plačiau kalbant, architektūros. Nekilnojamojo turto rinkos sąsajos su ne rinkos prekėmis kaip miesto architektūra leidžia numanyti architektūros kaip ne rinkos gėrybės vertę, atsiskleidžiančią perkant būstą.

*Kiti architektūrinės aplinkos rezultatai*. Vertę, kurią sukuria architektūrinė aplinka, atskleidė sisteminis Carmona literatūros tyrimas (2019). Jis buvo paremtas 271 moksliniu tyrimu, įtrauktu į apžvalgą, skirtą erdvės kokybės kuriamai vertei. Visas Carmona (2019) apimamas viešosios erdvės dimensijų spektras yra (1) sveikata, (2) visuomenė, (3) ekonomika ir (4) aplinka.

Apskritai galima teigti, kad mokslinės problemos ištirtumo lygis yra vidutinis. Architektūriniai veiksniai naudojami ekonometriniuose modeliuose, sprendžiant ir erdvinės priklausomybės klausimus, tačiau šie veiksniai greičiausiai yra kontroliniai kintamieji, o ne tyrimo objektas. Architektūrinių veiksnių tyrimai yra fragmentiški ir nesukuria bendro vaizdo.

## Tyrimo naujumas ir praktinė nauda

(1) *Nepaaiškintų būsto rinkos vertės veiksnių, kylančių iš kitų mokslo ir meno sričių – architektūros, nustatymas*. Erdvinių burbulų nustatymas būsto rinkoje miesto viduje. *Praktinė reikšmė*. Identifikuojama architektūros plačiąja prasme padėtis tarp meno, mokslo ir ekonomikos bei architektūrinių veiksnių padėtis ekonominėje literatūroje, tendencijose ir diskurse. Pateikiamas šių koncepcijų teorinis pagrindas įgyvendinti praktiškai. Šis tyrimas prideda dar vieną dimensiją – nepaaiškintą dispersiją erdvėje – būsto rinkos vertės tyrimams. Architektūra pristatoma kaip iracionalus veiksnys, galintis paaiškinti erdvinius rinkos vertės burbulus.

(2) *Būsto rinkos architektūrinių veiksnių sampratos patikslinimas ir tų veiksnių klasifikacija*. Identifikuojama architektūrinių veiksnių padėtis ekonominėje literatūroje, tendencijose ir diskurse. *Praktinė reikšmė*. Nors kai kurie architektūriniai veiksniai jau naudojami, siekiant pagerinti hedoninius būsto rinkos vertės modelius, būtų galima įtraukti daugiau architektūrinių veiksnių, ypač dizaino veiksnių.

Skirtumai tarp įvairių kintamųjų, tokių kaip buto dydis, stilius, pastato tipas, miesto tankumas ir kiti, nustatomi skirstant architektūrinius veiksnius į kategorijas. Šių veiksnių klasifikacija lemia galimas taikymo sritis.

(3) *Architektūrinių veiksnių įtakos būsto rinkos vertei teorinės bazės sukūrimas*. Šio tyrimo mokslinis naujumas – bandymas šias dvi tyrimų sritis (architektūrinius veiksnius ir rinkos vertę) sujungti į vieną teorinį modelį, kuris gali identifikuoti galimus būdus, kaip pagerinti aplinkos architektūrinių veiksnių ir jos rinkos vertės sąsajų supratimą. *Praktinė reikšmė*. Architektūrinių veiksnių įtakos būsto rinkos vertei teorinis modelis siūlo veiksnių ir dimensijų sistemą, kuri lemia būsto rinkos vertę. Sistema atspindi skirtingas būsto rinkos vertės dimensijas, daugiausia dėmesio skiriant dispersijai erdvėje tam tikru laiko momentu, taip pat nurodant būsimas tyrimų galimybes.

(4) *Architektūrinių veiksnių įtakos būsto rinkos vertei vertinimo modelis ir metodika*. Architektūriniai dizaino veiksniai pateikiami kaip iracionalūs veiksniai, galintys paaiškinti likutinę būsto rinkos vertės dispersiją erdvėje tam tikru laiko momentu. *Praktinė reikšmė*. Apibrėžiami pagrindiniai būsto rinkos vertės komponentai. Architektūrinių veiksnių įtakos būsto rinkos vertei vertinimo modelis siūlo galimus naudojamų turto vertinimo metodų patobulinimus ir gali lemti architektūros politikos pasiūlymus dėl investicijų pasiskirstymo tarp rinkos ir viešųjų gėrybių mieste.

**Tyrimo apribojimai ir ateities galimybės**

Tyrimo tema – architektūriniai veiksniai, būstas ir jo rinkos vertė. Teorinėje dalyje architektūra ir architektūrinė aplinka aprašomos plačiausia prasme, greitai susiaurinant apimtį iki būsto ir jo rinkos vertės dispersijos erdvėje, kad būtų galima atlikti empirinį tyrimą. Norint tai pasiekti, taikomi šie apribojimai:

(1) *Panaikintas rinkos vertės svyravimų laikui bėgant aspektas*. Duomenys renkami nustatytu laiko momentu, kad būtų pašalintas laiko poveikis. *Ateities galimybės*. Gali būti, kad makroekonominių veiksnių pokyčiai laikui bėgant gali pakeisti architektūrinių veiksnių reikšmę. Galima tirti dispersijos pokyčius erdvėje laikui bėgant.

(2) *Absoliutus rinkos vertės lygis nepatenka į šio tyrimo apimtį, naudojama tik santykinė rinkos vertė, lyginant butus vieną su kitu*. Visi rezultatai pateikiami santykinėmis vertėmis. *Ateities galimybės*. Jei būtų pridėtas laiko aspektas, absoliutus rinkos vertės lygis būtų dar viena būsto rinkos vertės tyrimo įžvalga.

(3) *Įvairių architektūros funkcijų skaičius apsiriboja tik būstu, empiriniam tyrimui naudojama tik butų rinkos vertė*. Būdama tik viena gana homogeniška architektūrinių objektų grupė, ji gali neatspindėti viso architektūrinių veiksnių įtakos būsto ar nekilnojamojo turto rinkos vertei potencialo. *Ateities galimybės*. Nors labai sunku kontroliuoti architektūros objektų heterogeniškumą, galima būtų išbandyti ir kitų tipų architektūrinius objektus, pavyzdžiui, biurus.

(4) *Empiriniame tyrime dizaino veiksnius atspindintys kintamieji apsiriboja urbanistiniais miesto projektavimo ir planavimo veiksniais*. Pastato lygio dizaino veiksniai lieka liekanose ir gali būti įvertinti tik maksimali galima jų įtaka, bet tai neįrodoma. *Ateities galimybės*. Galima būtų tirti pastato lygio dizaino veiksnius,

tokius kaip stilius, kompozicija ir kiti. Kokybinis tyrimas, pavyzdžiui, ekspertų apklausa, galėtų būti atskaitos taškas.

(5) *Nors Lietuvoje įprasta pirkti butą su žemės sklypo, kuriame yra pastatytas daugiabutis pastatas, dalimi, į žemės kainas šiame tyrime neatsižvelgiama*. Daroma prielaida, kad žemė yra neatskiriama daugiabučio namo dalis, o jos vertę įkūnija buto rinkos vertė dėl urbanistinių ir planavimo veiksnių. *Ateities galimybės*. Galima būtų įtraukti žemės kainų kontrolinius kintamuosius.

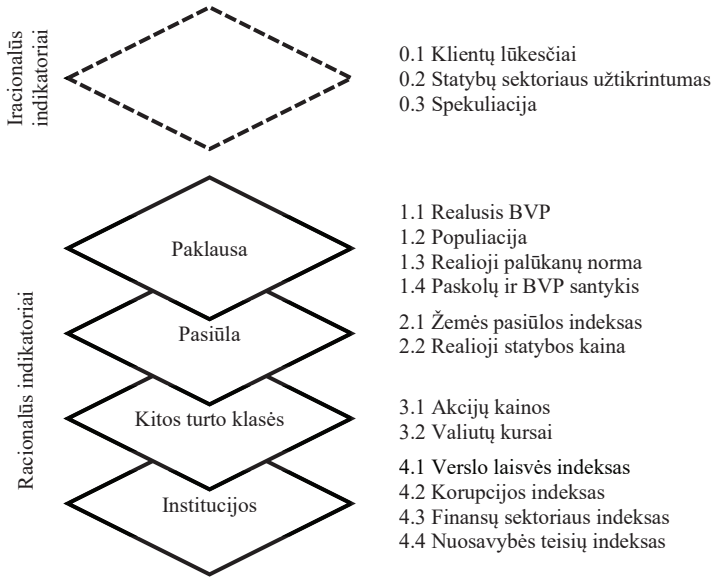
(6) *Miesto urbanistiniams ir planavimo veiksniams išmatuoti naudojamas Vilniaus miesto bendrasis planas*. Bendrasis planas atspindi esamą situaciją su ateities perspektyva. Turto rinkos apskritai žiūri į priekį, o nekilnojamojo turto rinka natūraliai jautri ilgalaikei perspektyvai, todėl logiška, kad būsto rinkos vertei daro įtaką į ateitį orientuoti veiksniai. *Ateities galimybės*. Miesto urbanistiniai ir planavimo veiksniai gali būti renkami rankiniu būdu; tačiau tam reikėtų ekspertinio vertinimo. Galima būtų atlikti tyrimus ir su kitais miestais.

## Tyrimo metodai

Šiame tyrime panaudotos turimos žinios tiriama tema, sisteminė teorinė analizė, praktinis konstravimo metodas ir teorinės perspektyvos vizualizavimas. Pasirinktas interpretacinis-konstruktyvus metodologinis požiūris, kuris leido atskleisti tiriamų reiškinių vertinimą ir struktūrą. Empirinis tyrimas įgyvendinamas naudojant koreliacijos, vienmatės regresijos, interpoliacijos ir daugiamatės regresijos metodus.

## Kontekstas: būsto rinkos vertės fundamentalioji dalis ir nepaaiškinti svyravimai laikui bėgant

*Būsto rinkos vertės fundamentalioji dalis*. Makroekonominiai veiksniai. Yra tyrimų, kuriuose bandoma rasti sąsajų tarp pagrindinių makroekonominių veiksnių ir būsto rinkos vertės bei jos svyravimų. Glindro ir kt. atliktas tyrimas (2011) daro prielaidą, kad kiekvienu laikotarpiu kiekvienoje vietovėje (šalyje ar mieste) egzistuoja fundamentalioji būsto vertė, kurią daugiausia lemia ekonominės sąlygos ir instituciniai veiksniai. Glindro ir kt. (2011) siūlo keturis aiškinamųjų kintamųjų blokus, pagrįstus teoriniais samprotavimais arba ankstesniais empiriniais tyrimais (1 pav.).




**1 pav**. Būsto rinkos vertę lemiančių veiksnių blokai. Šaltinis: Glindro ir kt. duomenys. (2011), autoriaus sukurta figūra.

Įvertinus būsto rinkos vertės fundamentaliąją vertę, gali būti pridėti kiti veiksniai, tokie kaip trumpalaikė dinamika ir nepaaiškinti ar iracionalūs veiksniai. Tupenaite ir kt. (2017) atskleidžia, kad būsto rinkos vertės svyravimai Lietuvoje 2005–2015 m. laikotarpiu daugiausia gali būti paaiškinti pagrindiniais ekonomikos rodikliais ir specifiniais būsto rinkos rodikliais (empirinis tyrimas atliktas analitinio hierarchijos proceso (AHP) metodu), tačiau čia būsto rinkos svyravimus lemiantys veiksniai skirstomi į racionalius ir iracionalius rodiklius. Rezultatai rodo, kad 80 % veiksnių yra racionalaus pobūdžio, o 20 %lieka iracionaliems veiksniams.

*Nepaaiškinti, arba iracionalūs, būsto rinkos vertės veiksniai*. Spekuliaciniai aspektai. Šiais laikais visuomenėje vyrauja įsitikinimas, kad būstas yra galimybė investuoti. Tačiau būsto rinka dar prieš kelis dešimtmečius dažniausiai nebuvo spekuliacinė. Vyravo įsitikinimas, kad būsto rinkos vertę lėmė statybos kaštai (Grebler ir kt., 1956). Šis įsitikinimas greitai pasikeitė, kai įžengėme į naują tūkstantmetį. Pagal S&P/Case-Shiller nacionalinį namų kainų indeksą (Shiller, 2007), 1996–2006 m. JAV būsto rinkos vertė padidėjo 86 %. Šį dramatišką kainų augimą būtų sunku paaiškinti būsto rinkos fundamentaliąja verte ir makroekonominiais veiksniais. Shiller (2007) daro išvadą, kad kiti svarbūs veiksniai turi įtakos būsto rinkos vertei. Galima daryti prielaidą apie iracionalų būsto rinkos vertės pobūdį.

Atsižvelgiant į tai, kad elgsenos ekonomika sudaro didelę rinkos iracionalumo dalį, galima iškelti hipotezę, kad architektūrinis dizainas, kaip žmogiškas veiksnys procese, gali turėti savo vaidmenį nustatant būsto rinkos vertę.

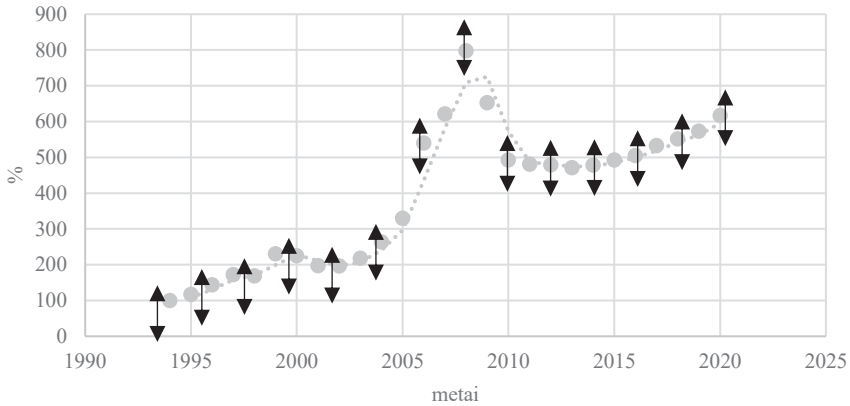
## Dispersija erdvėje ir erdviniai būsto rinkos vertės burbulai

*Būsto rinkos vertės erdvinė priklausomybė*. Ilgalaikis ir vidutinio laikotarpio būsto rinkos vertės svyravimas laikui bėgant yra pagrindinis daugelio tyrimų objektas.

Tačiau dispersijai erdvėje skiriamas mažesnis dėmesys. Erdvinės tendencijos yra neatsiejamos nuo būsto rinkos vertės duomenų. Siekiant išspręsti klausimą, kaip architektūriniai veiksniai paveikia būsto rinkos vertę, šios erdvinės tendencijos yra siejamos su architektūrinės aplinkos kokybe ir atitinkamai su architektūriniais veiksniais. Nuo šio momento disertacijos tyrimas yra orientuotas į fiksuotą laiko momentą, todėl eliminuojami veiksniai, kintantys laikui bėgant, tokie kaip makroekonominiai veiksniai. Burbulų sąvoka paimta iš iracionalių svyravimų laikui bėgant, tačiau, kadangi architektūra kinta erdvėje, ta pati sąvoka taikoma ir dispersijai erdvėje.

*Erdvinių burbulų nustatymas būsto rinkoje*. Kaip aprašyta anksčiau, yra didelis susidomėjimas būsto rinkos burbulų nustatymu ir modeliavimu laikui bėgant. Tačiau tų burbulų erdvinei dimensijai skiriama mažiau dėmesio. Remiantis rinkos pusiausvyros ir rinkos burbulų susidarymo teorija, šis tyrimas sutelktas į erdvinius butų rinkos vertės burbulus mieste. Toks požiūris suteikia dar vieną dimensiją būsto rinkos vertės dispersijai erdvėje ir burbulų reiškiniams.

Erdvinis burbulas gali būti apibrėžiamas kaip iracionalus būsto rinkos vertės nuokrypis nuo jo fundamentalios vertės, matuojant erdvėje tam tikru laiko momentu, taigi tomis pačiomis makroekonominėmis sąlygomis. Erdviniai burbulai gali būti vertinami kaip skirtingi nekilnojamojo turto ciklai skirtingose vietose; tačiau tos vietos turėtų atsirasti tokiomis pačiomis makroekonominėmis sąlygomis. Tai atitinka *ceteris paribus* prielaidą ir leidžia sutelkti dėmesį tik į erdvinę priklausomybę.



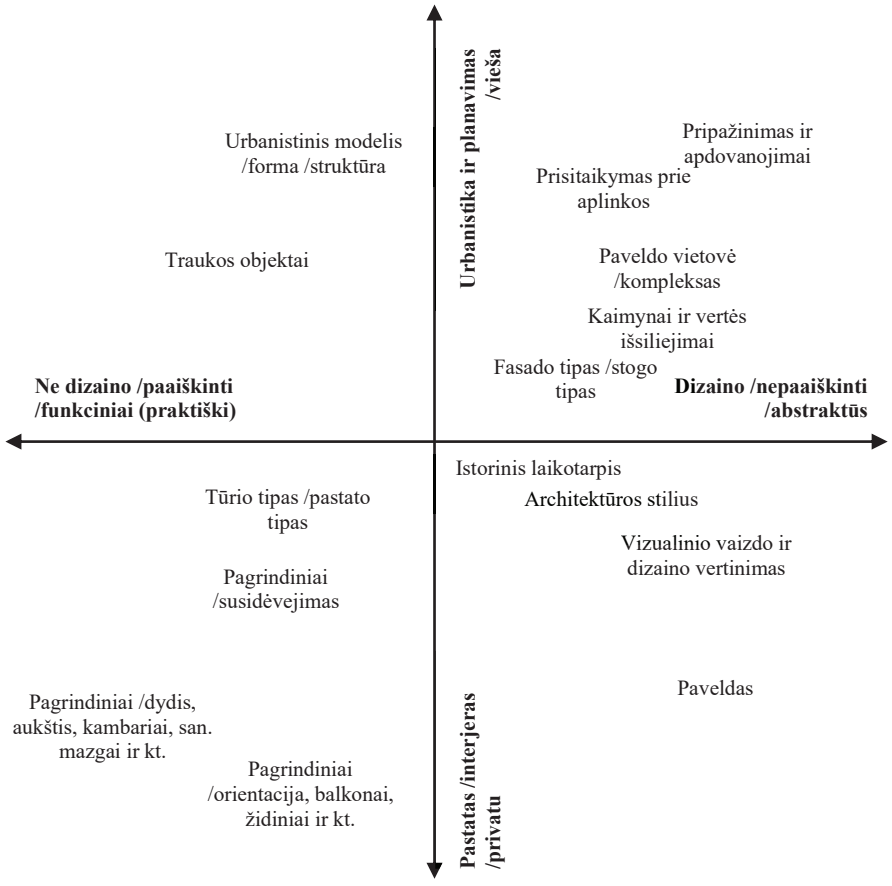

**3 pav**. Nematoma dispersija erdvėje Ober-Haus Lietuvos butų kainų indekse (OBHI) (1994 = 100). Šaltinis: Ober-Haus (2020), paveikslas modifikuotas autoriaus.

Būsto rinkos vertės burbulai laikui bėgant buvo vertinami kaip reikšmingas reiškinys, žiūrint į agreguotas reikšmes butų kainų indeksų laiko eilutėse (3 pav.), tačiau laiko eilučių grafikas „slepia“ rinkos vertės burbulų dispersiją erdvėje. Būsto kainų indeksai yra naudingi makroaplinkai tirti, tačiau, žiūrint miesto viduje, agreguotos reikšmės yra netikslios. Kiekvienas laiko eilutės grafiko taškas „slepia“ dispersiją erdvėje.

## Architektūrinių veiksnių teoriniai kontūrai

*Nekilnojamojo turto ekonomikos architektūriniai aspektai*. Nors architektūrą galima vertinti įvairiai, šiame tyrime naudojamas išplėstas architektūros, kaip meno ir erdvės mokslo, apibrėžimas. Architektūra nėra fizinis objektas, o erdvės konfigūracija, kuri yra funkcionali ir atspindi „geriausią panaudojimą“. Architektūrinių veiksnių sąvoka šiame tyrime reiškia kiekybinius ir kokybinius architektūrinės aplinkos matmenis, kurie gali atspindėti tą „geriausią panaudojimą“.

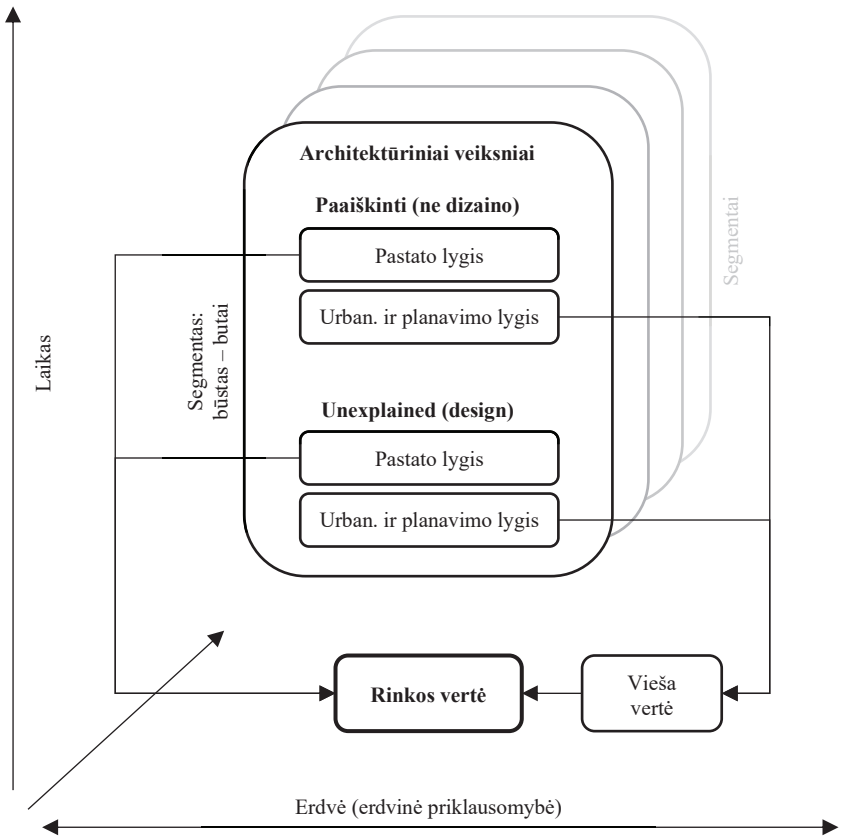
*Architektūrinių veiksnių klasifikacija*. Architektūrinių veiksnių vizualizacija dviejose dimensijose pateikta 9 pav. Išskiriamos dvi pagrindinės architektūrinių veiksnių dimensijos: (1) veiksniai, apimantys mastelius nuo pastato / interjero / privataus iki urbanistikos ir planavimo / viešo (iš apačios į viršų); (2) veiksniai, apimantys sritis nuo ne dizaino / paaiškintų / funkcionalių (utilitarinių) iki dizaino / nepaaiškintų / abstrakčių (iš kairės į dešinę).




**9 pav**. Architektūrinių veiksnių dimensijos ir kategorijos. Šaltinis: sukūrė autorius.

## Architektūrinių veiksnių įtakos būsto rinkos vertei empirinio tyrimo modelis ir metodika

*Teorinis architektūrinių veiksnių įtakos būsto rinkos vertei modelis*. Būsto rinkos vertę lemiančių architektūrinių veiksnių ekonominis mechanizmas pateiktas teoriniame modelyje (13 pav.). Į modelį įtraukus architektūrinius veiksnius, tikėtina, kad būsto rinkos vertės tikslumas padidėtų. Būsto rinkos vertės architektūriniai veiksniai skirstomi į dvi grupes: (1) paaiškintus (ne dizaino) ir (2) nepaaiškintus (dizaino) veiksnius. Abi šios grupės dar skirstomos į dvi mažesnes grupes: (1) pastato lygio ir (2) urbanistinio ir planavimo lygio veiksnius. Tai lemia 4 architektūrinių veiksnių kategorijas: (1) pastato ne dizaino, (2) urbanistinio ir planavimo ne dizaino, (3) pastato dizaino, (4) urbanistinio ir planavimo dizaino. Paaiškintą dispersiją galima paaiškinti ne dizaino veiksniais. Nepaaiškinta dispersija gali būti paaiškinta dizaino veiksniais. Geresni pastato lygio architektūriniai veiksniai tiesiogiai paveiktų būsto rinkos vertę. Geresni urbanistinio ir planavimo lygio architektūriniai veiksniai sukurtų viešąją vertę, kuri taip pat persiduoda būsto rinkos vertei.




**13 pav**. Architektūrinių veiksnių įtakos būsto rinkos vertei teorinis modelis. Šaltinis: sukūrė autorius.

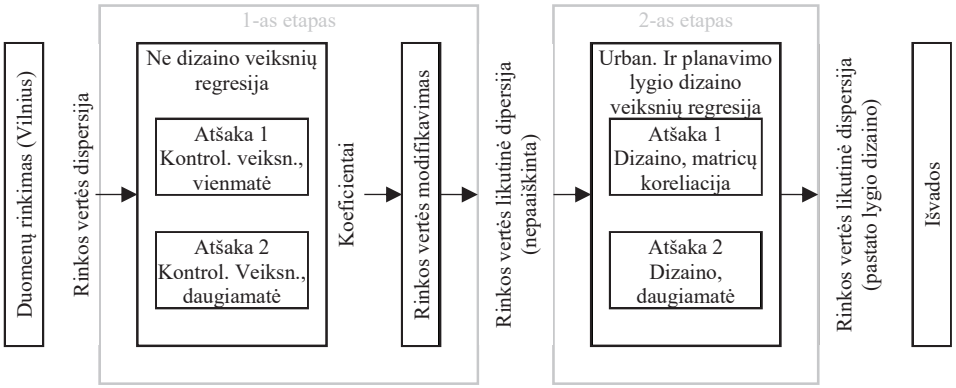
*Empirinio tyrimo strategija*. Siekiant šio tyrimo tikslo – įvertinti architektūrinių veiksnių įtaką būsto rinkos vertei, daromos trys pagrindinės strateginės prielaidos:

(1) *Erdvinis matmuo arba priklausomybė*. Nors įprasta stebėti būsto rinkos vertės svyravimus laikui bėgant, šio tyrimo naujumas išryškėja tiriant būsto rinkos vertės erdvinę dimensiją – dispersiją erdvėje.

(2) *Dizaino veiksniai*. Iškelta hipotezė, kad nepaaiškinta būsto rinkos vertės dispersija erdvėje gali būti siejama su architektūriniais dizaino veiksniais.

(3) *Miesto mastelis*. Rinkos vertė stebima miesto viduje.

*Empirinio tyrimo planas*. Empirinio tyrimo identifikavimo strategija. Tyrimas atliekamas dviem etapais, iš kurių abu turi dvi atšakas (14 pav.).

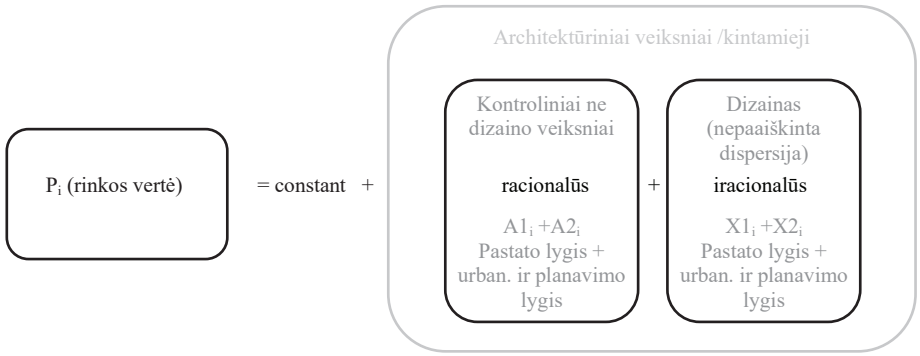



**14 pav**. Empirinio tyrimo planas. Šaltinis: sukūrė autorius.

Pirmojo etapo tikslas – gauti buto rinkos vertės likutinę nepaaiškintą dispersiją erdvėje pašalinus kontrolinių veiksnių (paaiškintų, ne dizaino) poveikį. Antrojo etapo tikslas – ištirti dizaino veiksnių įtaką būsto rinkos vertei.

*Empirinis architektūrinių veiksnių įtakos būsto rinkos vertei modelis*. Taip sukuriamas metodologinis pagrindas būsto rinkos vertės empiriniam modeliui sukurti: rinkos vertė priklauso nuo kontrolinių (pastato lygio ne dizaino ir urbanistinio ir planavimo lygio ne dizaino) veiksnių ir nepaaiškintų (pastato lygio dizaino ir urbanistinio ir planavimo lygio dizaino) veiksnių (15 pav.).

Kontekstas: *naujai pastatyti butai su daline apdaila




$P_i$ (rinkos vertė) = $C_i$ (kaštai) + nepaaiškinta /iracionalu (dizainas)

$C_i$ (kaštai) = constant + paaiškinta /racionalu (ne dizainas) + dalinai pastato lygio dizainas

**15 pav**. Empirinis architektūrinių veiksnių įtakos būsto rinkos vertei modelis. Šaltinis: sukūrė autorius.

*Pasirinkti duomenys ir tyrimo metodai*. Naudojami du būsto rinkos vertės ir urbanistinių ir planavimo veiksnių duomenų rinkiniai. Duomenys surinkti 2021 m. balandžio–gegužės mėn. Empiriniuose tyrimuose naudojami vienmatės regresijos, daugiamatės regresijos, erdvinės analizės – interpoliacijos, koreliacinės analizės metodai.

**Ne dizaino kontrolinių veiksnių vertinimas**

*Daugiamatė regresija*. Pirmojo etapo daugiamatės regresijos tikslas – gauti kontrolinių veiksnių koeficientus (paaiškintų, ne dizaino). Pridedami fiksuoti efektai, siekiant kontroliuoti skirtumus tarp skirtingų projektų (urbanistinius ir planavimo dizaino veiksnius). Daugiamatės regresijos rezultatai pateikti 6 lentelėje. Priklausomas kintamasis – buto kvadratinio metro kainos natūralusis logaritmas (ln(price_m2)), nepriklausomi kintamieji: aukštas, dydis, balkono dydis, dydžio / kambarių santykis bei projektų fiksuoti efektai. Nustatyta, kad visi koeficientai yra reikšmingi.

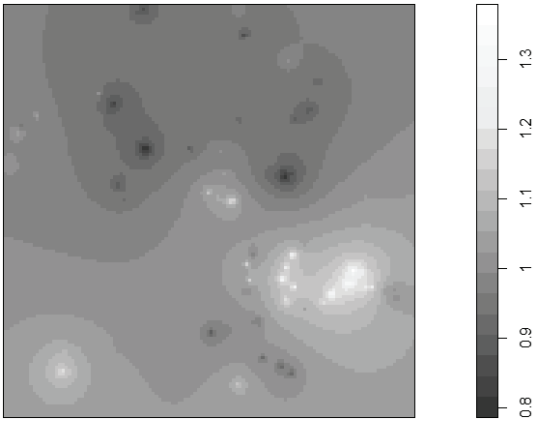
**6 lentelė**. Ne dizaino kontrolinių veiksnių įtakos kv. m kainai daugiamatės regresijos rezultatai. Šaltinis: sukūrė autorius.

| | *Dependent variable:* | | |
|---|---|---|---|
| | ln(price_m2) | | |
| | (1) | (2) | (3) |
| floor | 0.029*** | 0.029*** | 0.029*** |
| | (0.002) | (0.001) | (0.001) |
| size_m2 | -0.002*** | -0.003*** | -0.003*** |
| | (0.0002) | (0.0002) | (0.0002) |
| balcony_m2 | | 0.004*** | 0.004*** |
| | | (0.0004) | (0.0004) |
| size_rooms_resid | | | -0.001** |
| | | | (0.0005) |
| citus_misko_ardai | 0.041*** | 0.006 | 0.011 |
| | (0.015) | (0.014) | (0.015) |
| eika_baltas_lapas | 0.237*** | 0.213*** | 0.212*** |
| | (0.014) | (0.013) | (0.013) |
| galio_group_jomanto_parkas | -0.248*** | -0.239*** | -0.243*** |
| | (0.011) | (0.010) | (0.010) |
| hanner_verkiu_sodas | -0.103*** | -0.100*** | -0.106*** |
| | (0.012) | (0.011) | (0.011) |
| homa_giluzio_rivjera | -0.109*** | -0.108*** | -0.105*** |
| | (0.016) | (0.015) | (0.015) |
| homa_lazdyneliu_vingis | -0.180*** | -0.190*** | -0.192*** |
| | (0.010) | (0.009) | (0.009) |
| homa_vytenio4 | 0.305*** | 0.309*** | 0.307*** |
| | (0.016) | (0.014) | (0.014) |
| yit_matau_vilniu_iii | 0.326*** | 0.317*** | 0.323*** |
| | (0.012) | (0.011) | (0.011) |
| yit_naujasis_skansenas | | | |
| Constant | 7.861*** | 7.862*** | 7.854*** |
| | (0.015) | (0.014) | (0.014) |
| Observations | 522 | 522 | 522 |
| $R^2$ | 0.913 | 0.928 | 0.929 |
| Adjusted $R^2$ | 0.911 | 0.927 | 0.927 |
| Residual Std. Error | 0.061 (df = 511) | 0.055 (df = 510) | 0.055 (df = 509) |
| F Statistic | 536.854*** (df = 10; 511) | 598.605*** (df = 11; 510) | 555.129*** (df = 12; 509) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

*Nepaaiškinta būsto rinkos vertės likutinė dispersija erdvėje*. Pirmojo etapo pabaigoje abiejų atšakų paaiškintų ne dizaino veiksnių koeficientai naudojami duomenų rinkinio Nr. 2 (ntzemelapis.lt) butų rinkos vertės duomenims modifikuoti.

Pasirinktas 10x10 km Vilniaus plotas (26 pav.). Likutinės dispersijos erdvėje (statistinio paviršiaus) diagrama sudaroma iš modifikuotų butų rinkos vertės duomenų (27 pav.).


**26 pav**. Vilniaus žemėlapis. Šaltinis: maps.lt (2021), paveikslas modifikuotas autoriaus.




**27 pav**. Nepaaiškinamos likutinės butų rinkos vertės dispersijos erdvėje Vilniuje statistinio paviršiaus diagrama. Šaltinis: sukūrė autorius.

Pirmojo etapo rezultatai patvirtina hipotezę:

(1) Ne dizaino kontroliniai architektūriniai veiksniai (floor, size_m2…) turi statistiškai reikšmingą įtaką butų rinkos vertei (price_m2) (1 etapas).

**Dizaino veiksnių įtakos būsto rinkos vertei vertinimas**

*Daugiamatė regresija*. Antrame etape atliekama modifikuotų rinkos vertės duomenų (likutinės dispersijos erdvėje) daugiamatė regresija. Priklausomi kintamieji – urbanistiniai ir planavimo dizaino veiksniai. Regresijos rezultatų suvestinė pateikta 8 lentelėje.

**8 lentelė**. Dizaino veiksnių įtakos kv. m kainai daugiamatės regresijos rezultatai. Šaltinis: sukūrė autorius.

| | *Dependent variable:* | | |
|---|---|---|---|
| | ln(price_m2_modified) | | |
| | (1) | (2) | (3) |
| intensity | -1.174*** | | |
| | (0.091) | | |
| intensity_density_resid | | -0.874*** | -0.855*** |
| | | (0.120) | (0.117) |
| density | | -1.413*** | -1.705*** |
| | | (0.115) | (0.124) |
| height_max | 1.010*** | 1.036*** | 0.721*** |
| | (0.099) | (0.098) | (0.111) |
| commerce | | | 0.559*** |
| | | | (0.102) |
| Constant | 7.966*** | 8.169*** | 8.208*** |
| | (0.094) | (0.113) | (0.110) |
| Observations | 576 | 576 | 576 |
| $R^2$ | 0.250 | 0.268 | 0.305 |
| Adjusted $R^2$ | 0.247 | 0.264 | 0.300 |
| Residual Std. Error | 0.291 (df = 573) | 0.287 (df = 572) | 0.280 (df = 571) |
| F Statistic | 95.507*** (df = 2; 573) | 69.763*** (df = 3; 572) | 62.551*** (df = 4; 571) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

*Dizaino veiksnių įtaka nepaaiškintai likutinei būsto rinkos vertės dispersijai erdvėje*. Yra ryšys tarp rinkos vertės ir urbanistinių ir planavimo dizaino veiksnių. Urbanistiniai ir planavimo dizaino veiksniai gali paaiškinti 30 % nepaaiškintos likutinės dispersijos erdvėje arba 9 % bendros butų rinkos vertės dispersijos erdvėje.

Antrojo etapo rezultatai patvirtina hipotezę:

(2) Urbanistiniai ir planavimo dizaino veiksniai turi statistiškai reikšmingą įtaką butų rinkos vertei (price_m2) (2 etapas).

**Rezultatų apibendrinimas ir diskusija**

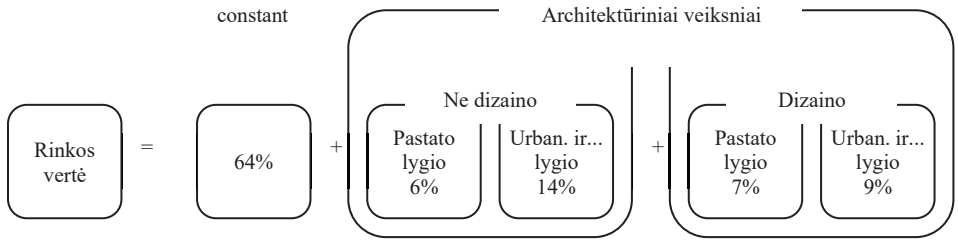
Mieste buvo rasta daug nepaaiškintų erdvinių rinkos vertės skirtumų. Šis reiškinys nusipelno didesnio dėmesio būsto rinkos vertės nustatymo tyrimuose. Tai taip pat prideda dar vieną būsto rinkos burbulų dimensiją, kurią galima vertinti kaip erdvinį rinkos segmentavimą iš vietinės pasiūlos ir paklausos perspektyvos. Nors pasiūla, paklausa ir susidariusios subrinkos yra pagrindiniai būsto rinkos vertės

nustatymo proceso elementai, susidariusios subrinkos priklauso nuo nepaaiškintų veiksnių, tokių kaip urbanistinių ir planavimo dizainas ar pastatų dizainas.

Pagrindinis aspektas nustatant erdvinius burbulus būsto rinkoje yra tai, kad pasiūla ir paklausa yra ne globali, o labiau lokali. Dėl nekilnojamojo turto prigimties mikroaplinkose atsiranda erdviškai išsidėsčiusių subrinkų. Ekonomika rinkos vertės modelius konstruoja pagal pasiūlą ir paklausą, tačiau mažesnės ar didesnės paklausos priežastys kelia daugiau klausimų ir peržengia ekonomikos ribas. Tyrimas siūlo sujungti pasiūlos ir paklausos modelius su architektūra. Šis holistinis požiūris gilina supratimą apie būsto rinkos vertės nustatymo proceso struktūrą.

Peržiūrėta urbanistinio ir planavimo lygmens veiksnių bei pastato lygio veiksnių padėtis hedoniniuose modeliuose. Tai kelia klausimus apie architektūrinių veiksnių padėtį šiuose hedoniniuose modeliuose. Nors visi šie veiksniai yra architektūriniai, urbanistinio ir planavimo lygmens ne dizaino ir pastato lygmens ne dizaino veiksniai gali būti paaiškinti, o urbanistinio ir planavimo lygmens dizaino ir pastato lygmens dizaino – nepaaiškinti. Nors šiuos nepaaiškintus veiksnius sunku išmatuoti, tai kelia diskusiją apie hedoninių savybių apimtį, kuria galime pasikliauti nustatydami būsto rinkos vertę.

Įvertinus ne dizaino veiksnius, pastebima iki 16% nepaaiškinta butų rinkos vertės dispersija erdvėje ir dėl to identifikuojami erdviniai burbulai Vilniaus miesto butų rinkoje. Priežastinis šios dispersijos pobūdis dar nepatvirtintas, tačiau, taikant hedonines savybes siekiant pašalinti individualų objektų heterogeniškumą, akivaizdu, kad šie butai skiriasi savo architektūrine išvaizda ir aplinka. Kitas empirinio tyrimo etapas buvo dizaino veiksnių įtakos tyrimas. Patvirtinta urbanistinio ir planavimo dizaino veiksnių reikšmė, prisidedanti 9% prie dispersijos erdvėje ir paliekanti pastato dizaino veiksnius liekanose. Vidutinė bendra butų rinkos vertės veiksnių kompozicija (32 pav.): pastovi dalis – 64%, pastato ne dizaino – 6%, urbanistiniai ir planavimo ne dizaino – 14%, pastato dizaino (+ paklaidos) – 7% , urbanistiniai ir planavimo dizaino – 9 proc. Architektūrinių veiksnių įtakos būsto rinkos vertei dekompozicija parodo, kokia būsto rinkos vertės dispersija erdvėje lieka pašalinus kiekvieną architektūrinių veiksnių grupę.




**32 pav**. Architektūrinių veiksnių įtakos būsto rinkos vertei dekompozicija. Šaltinis: autorių analizė.

Kaip ir šioje disertacijoje, daugelyje kitų tyrimų buvo naudojami hedoniniai modeliai ir panelinių duomenų daugiamatė regresinė analizė, tačiau daugelyje kitų tyrimų architektūros kokybei įvertinti buvo naudojamas ekspertinis vertinimas. Glindro ir kt. (2011) taip pat naudojo atskirus empirinio tyrimo etapus, patvirtinančius, kad tai gali būti gera būsto rinkos vertės dekompozicijos ir fundamentaliųjų bei iracionalių dalių skaičiavimo strategija. Glindro ir kt. (2011) daro išvadą, kad yra daug ką nuveikti tiriant būsto kainų dinamiką. Teigiama, kad nacionalinė agreguota būsto rinkos vertė slepia rinkos vertės dispersiją tarp miestų ar rinkos segmentų. Todėl, norint nustatyti vietinių rinkų burbulus, reikėtų miesto lygmens duomenų. Šioje disertacijoje remiamasi šia idėja, nors ir ne miesto, o rajono ar pastato lygiu. Erdvės skirtumai yra jautresni galutiniam vartotojui, nes bendri svyravimai laikui bėgant yra globalūs miesto mastu, o dispersija erdvėje mieste palieka klientui pasirinkimą miesto viduje.

Nepaaiškinta ar iracionali rinkos vertės dalis literatūroje – 5–28 % kainos / nuomos priemoka (vidutiniškai 13,8 %) panaši į šios disertacijos rezultatus – 16 %. Literatūroje vidutinis procentas mažesnis, nes visi tie tyrimai buvo orientuoti į kokios nors siauresnės specifinių veiksnių grupės poveikį. Taip pat labai sunku atskirti urbanistinius ir planavimo ne dizaino veiksnius nuo urbanistinio ir planavimo dizaino veiksnių, nes urbanistinis ir planavimo dizainas įkvepia ir kuria skirtingų miesto vietovių savybės. Ši sritis reikalauja daugiau teorinių ir empirinių tyrimų.

**Išvados**

1. Teorinių prielaidų pirmosios dalies apie būsto rinkos vertės svyravimus laikui bėgant pagrindinės sampratos: fundamentalioji dalis ir nepaaiškinta iracionali dalis; racionalūs ir iracionalūs veiksniai (ne dizaino ir dizaino veiksniai). Šios sąvokos sudaro teorinį šio tyrimo pagrindą. Yra paaiškinta / racionali ir nepaaiškinta / iracionali būsto rinkos vertės dalys. Literatūroje įprasta, kad būsto rinkos vertę sudaro fundamentalioji ir nepaaiškinta dalys. Tai taip pat gali būti vadinama racionalia ir iracionalia dalimis. Tokia būsto rinkos vertės struktūra atspindi platesnį ekonominį kontekstą – tradicinė ekonomika gali paaiškinti fundamentaliąją dalį, o iracionaliai daliai paaiškinti reikia įtraukti kitas mokslo sritis.
2. Antroje teorinių prielaidų dalyje būsto rinkos vertės dispersijai erdvėje fiksuotu laiko momentu taikomos tos pačios sąvokos, kaip ir žvelgiant į būsto rinkos vertės svyravimus laikui bėgant. Apibendrinant gali būti išskirtos įvairios būsto rinkos vertės dimensijos: dispersija erdvėje, svyravimai laikui bėgant, poslinkis tarp skirtingų būsto segmentų. Toliau šiame tyrime pagrindinis dėmesys skiriamas dispersijai erdvėje (erdvinei priklausomybei), kuri natūraliai yra susijusi su architektūrinės aplinkos pokyčiais erdvėje. Architektūriniai veiksniai yra integruoti į architektūrinę aplinką, kuri natūraliai gali būti siejama su būsto rinkos vertės dispersija erdvėje. Įvairiose vietose vyksta skirtingi būsto rinkos vertės ciklai, dėl kurių erdvėje atsiranda nepaaiškintų rinkos vertės skirtumų, taigi ir erdvinių burbulų. Remiantis elgsenos ekonomikos pavyzdžiu, reikėtų tirti ir galimas kitas susijusias mokslo sritis, kad geriau suprastume šią

nepaaiškintą dispersiją erdvėje. Iškeliama hipotezė, kad architektūriniai veiksniai gali paaiškinti tiek racionalią, tiek iracionalią būsto rinkos vertės dalis.

3. Egzistuoja dvi pagrindinės architektūrinių veiksnių dimensijos. Taip sukuriamos keturios architektūrinių veiksnių kategorijos: (1) pastato lygmens ne dizaino (paaiškinti / racionalūs / rinkos / privatūs), (2) miesto ir planavimo lygmens ne dizaino (paaiškinti / racionalūs / ne rinkos / vieši), (3) pastato lygmens dizaino (nepaaiškinti /iracionalus / rinkos / privatūs), (4) urbanistinio ir planavimo lygmens dizaino (nepaaiškinti / iracionalūs / ne rinkos / vieši). Nėra aiškios ribos tarp ne dizaino (kontrolinių) ir dizaino veiksnių. Tarp šių veiksnių yra laipsniškas perėjimas, todėl egzistuoja iššūkis kontroliuoti heterogeniškumą, vietą ir kaimynystę bei išskirti dizaino veiksnius. Šiame tyrime daugiausia dėmesio skiriama architektūriniams veiksniams apskritai ir konkrečiai architektūriniams dizaino veiksniams. Architektūra yra ne tik pastato lygio dizainas, bet ir ne dizaino veiksniai bei urbanistinio ir planavimo lygio veiksniai. Tai padeda struktūrizuoti veiksnius būsto rinkos vertės tyrimų hedoniniuose modeliuose.
4. Būsto rinkos vertę ir architektūrinės aplinkos vertę lemiantys veiksniai yra suskirstyti į privačią vertę (pastato lygis) ir viešąją vertę (miesto ir planavimo lygis). Didelė būsto rinkos vertės dalis apima ne rinkos lauką ir tada modifikuoja pastato lygio rinkos vertę. Tai socialinė dilema, nes kvartalus kuria ne pavieniai pastatai, o pastatų grupės, kurios ir yra sudarytos iš tų pačių pastatų, kurie galiausiai padidina savo vertę, jei veikia grupės naudai. Todėl urbanistiniai ir planavimo veiksniai yra tokie reikšmingi būsto rinkos vertės nustatymo procese. Tai atitinka įsitikinimą, kad vieta yra labai svarbi būsto rinkos vertės nustatymo procese, o vietą iš tikrųjų sukuria miesto ir planavimo veiksniai. Tačiau įdomiausia yra tai, kad urbanistinio ir planavimo lygio veiksnius bendromis pastangomis sukuria pastato lygio architektūriniai veiksniai.
5. Teorinis architektūrinių veiksnių įtakos būsto rinkos vertei modelis apima visas anksčiau minėtas sąvokas (paaiškintą ir nepaaiškintą dalis, keturias architektūrinių veiksnių kategorijas, laiko, erdvinę dimensijas, būsto segmentus, rinkos vertę ir viešąją vertę) į vieną modelį. Tai sukuria pagrindą empirinio tyrimo modeliui. Remiantis teorine dalimi, daroma prielaida, kad būsto rinkos vertę sudaro pastovioji dalis, kontrolinių veiksnių dalis ir nepaaiškinta dalis. Teoriškai ir metodiškai pastovioji dalis yra fundamentalioji būsto rinkos vertės dalis. Kontroliniai veiksniai gali būti toliau skaidomi į pastato lygio ne dizaino veiksnius ir miesto bei planavimo lygio ne dizaino veiksnius. Nepaaiškinta dalis gali būti toliau skaidoma į pastato lygio dizaino veiksnius ir miesto bei planavimo lygio dizaino veiksnius. Siekiant dekomponuoti būsto rinkos vertę, empirinis tyrimas skaidomas į du etapus, po kurių skaičiuojama likutinė dispersija erdvėje.
6. Pirmojo etapo rezultatai patvirtina hipotezę, kad ne dizaino architektūriniai veiksniai (floor, size_m2…) turi statistiškai reikšmingą įtaką butų rinkos vertei (price_m2). Regresijos modelis rodo, kad: didesnė aukšto vertė teigiamai veikia kv. m kainą; didesnis buto dydis neigiamai veikia kv. m kainą; didesnis balkonas teigiamai veikia kv. m kainą; mažesnis kambarių skaičius neigiamai veikia kv.

m kainą. Galima sakyti, kad žmonės nori gyventi aukščiau, su didesniais balkonais, o mažesnio ploto butų kv. m kaina didesnė. Be to, jei kambarių skaičius yra vienodas, mažesnio ploto butas turi didesnę rinkos vertę. Šie rezultatai atitinka literatūrą ir ekonominę intuiciją. Nors šių ne dizaino kontrolinių architektūrinių veiksnių reikšmė yra svarbi, pirmojo etapo indėlis yra pašalinti šių veiksnių poveikį, paliekant nepaaiškintą likutinę būsto rinkos vertės dispersiją erdvėje.

7. Antrojo etapo rezultatai patvirtina hipotezę, kad urbanistiniai ir planavimo dizaino veiksniai turi statistiškai reikšmingą įtaką butų rinkos vertei (price_m2). Regresijos modelis rodo, kad: didesnis intensyvumas neigiamai veikia kv. m kainą; didesnis tankumas taip pat neigiamai veikia kv. m kainą; tačiau didesnis pastatų aukštis teigiamai veikia kv. m kainą; taip pat prekybinių patalpų kiekis teigiami veikia kv. m kainą. Galima sakyti, kad žmonės nori pirkti butus aukščiau, vietose, kur šalia yra daugiau prekybos, tačiau nori gyventi ne taip tankiai užstatytame rajone. Šie rezultatai atitinka ekonominę intuiciją. Antrojo etapo indėlis – patvirtinti urbanistinio ir planavimo lygio dizaino veiksnių įtakos būsto rinkos vertei reikšmingumą.
8. Rezultatų apibendrinimas rodo, kad, pašalinus ne dizaino veiksnių poveikį, pastebima iki 16 % nepaaiškinta butų rinkos vertės likutinė dispersija erdvėje. Akivaizdu, kad šie butai skiriasi savo architektūrine išvaizda ir aplinka. Patvirtintas urbanistinio ir planavimo lygio dizaino veiksnių reikšmingumas, prisidedantis 9 % prie rinko vertės dispersijos erdvėje, paliekant pastato lygio dizaino veiksnius liekanose. Vidutinė bendra buto rinkos vertės veiksnių kompozicija: pastovi dalis – 64 %, pastato lygio ne dizaino – 6 %, urbanistiniai ir planavimo ne dizaino – 14 %, pastato lygio dizaino (+ paklaidos) – 7 %, urbanistiniai ir planavimo dizaino – 9 %. Nors empiriniam tyrimui buvo pasirinktas Vilnius, modelis gali būti pritaikytas bet kuriam kitam miestui. Ši disertacija sukuria ateities tyrimų galimybes, siekiant patvirtinti būsto ar bet kurio kito nekilnojamojo turto segmento rinkos vertės modelio kompozicijos patikimumą laikui bėgant ir rezultatus.

## REFERENCES


1. Agnello, L., & Schuknecht, L. (2009). Booms and busts in housing markets: determinants and implications. *European Central Bank Working Paper Series*, *No. 1071*.
2. Ahlfeldt, G., Holman, N., & Wendland, N. (2012). *An Assessment of the Effects of Conservation Areas on Value. Final report*. London School of Economics and Political Science.
3. Ahlfeldt, G., & Mastro, A. (2012). Valuing Iconic Design: Frank Lloyd Wright Architecture in Oak Park, Illinois. *Housing Studies*, *27*(8), 1079-1099. https://doi.org/10.1080/02673037.2012.728575
4. AI. (1996). *The appraisal of real estate*. Appraisal Institute.
5. Anderson, L. M., & Cordell, H. K. (1988). Influence of Trees on Residential Property Values in Athens, Georgia (U.S.A.): A Survey based on Actual Sales Prices. *Landscape and Urban Planning*, *15*, 153-164.
6. Anderson, S., & West, S. (2006). Open Space, Residential Property Values, and Spatial Context. *Regional Science and Urban Economics*, *36*, 773-789. https://doi.org/10.1016/j.regsciurbeco.2006.03.007
7. Anselin, L. (1988). *Spatial econometrics: methods and models*. Kluwer Academic Publishers.
8. Aranburu, I., Plaza, B., & Esteban, M. (2016). Sustainable Cultural Tourism in Urban Destinations: Does Space Matter? *Sustainability*, *8*(8), Article 699. https://doi.org/10.3390/su8080699
9. Asabere, P., Hachey, G., & Grubaugh, S. (1989). Architecture, Historic Zoning, and the Value of Homes. *The Journal of Real Estate Finance and Economics*, *2*, 181-195. https://doi.org/10.1007/BF00152347
10. Baker, D. (2002). The Run-up in Home Prices: A Bubble. *Challenge*, *45*(6), 93-119. https://doi.org/10.1080/05775132.2002.11034180
11. Barber, B., & Odean, T. (2008). All That Glitters: The Effect of Attention and News on the Buying Behavior of Individual and Institutional Investors. *Review of Financial Studies*, *21*(2), 785-818.
12. Bartholomew, K., & Ewing, R. (2011). Hedonic Price Effects of Pedestrian- and Transit-Oriented Development. *Journal of Planning Literature*, *26*(1), 18-34. https://doi.org/10.1177/0885412210386540
13. Been, V., Ellen, I. G., Gedal, M., Glaeser, E., & McCabe, B. J. (2016). Preserving history or restricting development? The heterogeneous effects of historic districts on local housing markets in New York City. *Journal of Urban Economics*, *92*, 16-30. https://doi.org/10.1016/j.jue.2015.12.002
14. Bell, D. (2005). The Emergence of Contemporary Masterplans: Property Markets and the Value of Urban Design. *Journal of Urban Design*, *10*(1), 81-110. https://doi.org/10.1080/13574800500062387
15. Benos, E., & Jochec, M. (2013). Patriotic name bias and stock returns. *Journal of Financial Markets*, *16*(3), 550-570.
16. Blank, D. M., & Winnick, L. (1953). The Structure of the Housing Market. *The Quarterly Journal of Economics*, *67*(2), 181-208.

17. Borio, C., & McGuire, P. (2004). Twin peaks in equity and housing prices? *BIS Quarterly Review*.
18. Bowes, D. R., & Ihlanfeldt, K. R. (2001). Identifying the Impacts of Rail Transit Stations on Residential Property Values. *Journal of Urban Economics*, *50*(1), 1-25. https://doi.org/https://doi.org/10.1006/juec.2001.2214
19. Bowler, D. E., Buyung-Ali, L., Knight, T. M., & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence. *Landscape and Urban Planning*, *97*(3), 147-155. https://doi.org/10.1016/j.landurbplan.2010.05.006
20. Buitelaar, E., & Schilder, F. (2017). The Economics of Style: Measuring the Price Effect of Neo-Traditional Architecture in Housing. *Real Estate Economics*, *45*(1), 7-27. https://doi.org/10.1111/1540-6229.12137
21. CABE. (2003). *The Value of Housing Design and Layout*. Commission for Architecture and the Built Environment.
22. CABE. (2005). *Does Money Grow on Trees?* Commission for Architecture and the Built Environment.
23. CABE. (2007). *Paved with Gold: The Real Value of Street Design*. Commission for Architecture and the Built Environment.
24. CABE. (2009). *Making the Invisible Visible: The Real Value of Park Assets*. Commission for Architecture and the Built Environment.
25. Callicott, J. B., & Shaner, D. E. (1989). *In Defense of the Land Ethic: Essays in Environmental Philosophy*. State University of New York Press.
26. Cameron, G., Muellbauer, J., & Murphy, A. (2006). Was There a British House Price Bubble? Evidence from a Regional Panel. In (pp. 45): CEPR Discussion Paper No. 5619.
27. Can, A. (1990). The Measurement of Neighborhood Dynamics in Urban House Prices. *Economic Geography*, *66*(3), 254-272. https://doi.org/10.2307/143400
28. Can, A. (1992). Specification and estimation of hedonic housing price models. *Regional Science and Urban Economics*, *22*(3), 453-474. https://doi.org/10.1016/0166-0462(92)90039-4
29. Capozza, D., Hendershott, P., Mack, C., & Mayer, C. (2002). Determinants of Real House Price Dynamics. *National Bureau of Economic Research Working Paper Series*, *No. 9262*.
30. Carmona, M. (2015). London's local high streets: The problems, potential and complexities of mixed street corridors. *Progress in Planning*, *100*, 1-84. https://doi.org/https://doi.org/10.1016/j.progress.2014.03.001
31. Carmona, M. (2019). Place value: place quality and its impact on health, social, economic and environmental outcomes. *Journal of Urban Design*, *24*(1), 1-48. https://doi.org/10.1080/13574809.2018.1472523
32. Carmona, M., De Magalhaes, C., Edwards, M., Awuor, B., & Aminossehe, S. (2001). *The Value of Urban Design*. Thomas Telford.
33. Carmona, M., Gabrieli, T., Hickman, R., Laopoulou, T., & Livingstone, N. (2017). Street appeal: The value of street improvements. *Progress in Planning*, *126*, 1-51. https://doi.org/https://doi.org/10.1016/j.progress.2017.09.001
34. Case, K., & Shiller, R. (2003). Is There a Bubble in the Housing Market? *Brookings Papers on Economic Activity*, *34*(2), 299-362.

35. CBRE. (2017). Place Making, Value and the Public Realm. In. London: CBRE.

36. Cellmer, R., & Trojanek, R. (2019). Towards increasing residential market transparency: Mapping local housing prices and dynamics. *ISPRS International Journal of Geo-Information, 9*(1). https://doi.org/10.3390/ijgi9010002

37. Cervero, R., & Duncan, M. (2004). Neighbourhood Composition and Residential Land Prices: Does Exclusion Raise or Lower Values? *Urban Studies*, *41*(2), 299-315. https://doi.org/10.1080/0042098032000165262

38. Champ, P. A., Boyle, K., & Brown, T. C. (2017). *A Primer on Nonmarket Valuation*. Dordrecht: Springer.

39. Chen, Y., Li, X., Zheng, Y., Guan, Y., & Liu, X. (2011). Estimating the relationship between urban forms and energy consumption: A case study in the Pearl River Delta, 2005–2008. *Landscape and Urban Planning*, *102*, 33–42. https://doi.org/10.1016/j.landurbplan.2011.03.007

40. Cocco, J. (2005). Portfolio Choice in the Presence Housing. *Review of Financial Studies*, *18*, 535-567. https://doi.org/10.2139/ssrn.258428

41. Correll, M. R., Lillydahl, J. H., & Singell, L. D. (1978). The Effects of Greenbelts on Residential Property Values: Some Findings on the Political Economy of Open Space. *Land Economics*, *54*(2), 207-217.

42. Costanza, R., & Folke, C. (1997). Valuing ecosystem services with efficiency, fairness and sustainability as goals. In G. Daily (Ed.), *Nature's Services: Societal Dependence on Natural Ecosystems* (pp. 49-70). Island Press.

43. Coulson, N. E., & Lahr, M. L. (2005). Gracing the Land of Elvis and Beale Street: Historic Designation and Property Values in Memphis. *Real Estate Economics*, *33*(3), 487-507. https://doi.org/10.1111/j.1540-6229.2005.00127.x

44. Coxhead, P. (1974). Measuring the relationship between two sets of variables. *British Journal of Mathematical and Statistical Psychology, 27*(2), 205-212. https://doi.org/10.1111/j.2044-8317.1974.tb00541.x

45. Czembrowski, P., & Kronenberg, J. (2016). Hedonic pricing and different urban green space types and sizes: Insights into the discussion on valuing ecosystem services. *Landscape and Urban Planning*, *146*, 11-19. https://doi.org/https://doi.org/10.1016/j.landurbplan.2015.10.005

46. Dewaelheyns, V., Vanempten, E., Bomans, K., Verhoeve, A., & Gulinck, H. (2014). The Fragmentation Bias in Valuing and Qualifying Open Space. *Journal of Urban Design*, *19*. https://doi.org/10.1080/13574809.2014.923741

47. Diao, M., & Ferreira, J. (2010). Residential Property Values and the Built Environment:Empirical Study in the Boston, Massachusetts, Metropolitan Area. *Transportation Research Record*, *2174*(1), 138-147. https://doi.org/10.3141/2174-18

48. Drachal, K. (2014). Property Prices and Regional Labor Markets in Poland. *The European Journal of Applied Economics*, *11*(1), 5-15.

49. Dubin, R. A. (1988). Estimation of Regression Coefficients in the Presence of Spatially Autocorrelated Error Terms. *The Review of Economics and Statistics*, *70*(3), 466-474. https://doi.org/10.2307/1926785

50. Durkheim, É. (1933). *The Division of Labor in Society*. Free Press.

51. Egert, B., & Mihaljek, D. (2007). Determinants of House Prices in Central and Eastern Europe. *Comparative Economic Studies*, *49*.

https://doi.org/10.1057/palgrave.ces.8100221

52. EH. (2002). *Heritage Dividend 2002 - Measuring the Results of Heritage Regeneration 1999-2002*. English Heritage.
53. Ewing, R., & Dumbaugh, E. (2009). The Built Environment and Traffic Safety:A Review of Empirical Evidence. *Journal of Planning Literature*, *23*(4), 347-367. https://doi.org/10.1177/0885412209335553
54. Ewing, R., & Rong, F. (2008). The impact of urban form on U.S. residential energy use. *Housing Policy Debate*, *19*(1), 1-30. https://doi.org/10.1080/10511482.2008.9521624
55. Fadaei, S., Iulo, L. D., & Yoshida, J. (2015). Architecture: A missing piece in real-estate studies of sustainable houses. *Defining the Future of Sustainability and Resilience in Design, Engineering and Construction*, *118*, 813-818. https://doi.org/10.1016/j.proeng.2015.08.518
56. Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, *25*(2), 383-417. https://doi.org/10.2307/2325486
57. Fuerst, F., McAllister, P., & Murray, C. B. (2011). Designer Buildings: Estimating the Economic Value of 'Signature' Architecture. *Environment and Planning A: Economy and Space*, *43*(1), 166-184. https://doi.org/10.1068/a43270
58. Garber, P. M. (1990). Famous First Bubbles. *Journal of Economic Perspectives*, *4*(2), 35-54. https://doi.org/10.1257/jep.4.2.35
59. Gat, D. (1998). Urban Focal Points and Design Quality Influence Rents: The Case of the Tel Aviv Office Market. *The Journal of Real Estate Research*, *16*(2), 229-247.
60. Glaeser, E. (2017). Real Estate Bubbles and Urban Development. *Asian Development Review*, *34*, 114-151. https://doi.org/10.1162/adev_a_00097
61. Glaeser, E. L., & Gottlieb, J. D. (2008). The Economics of Place-Making Policies. In *National Bureau of Economic Research Working Paper Series*: No. 14373.
62. Glaeser, E. L., Gyourko, J., & Saiz, A. (2008). Housing supply and housing bubbles. *Journal of Urban Economics*, *64*(2), 198-217. https://doi.org/https://doi.org/10.1016/j.jue.2008.07.007
63. Glaeser, E. L., Kincaid, M. S., & Naik, N. (2018). Computer Vision and Real Estate: Do Looks Matter and Do Incentives Determine Looks. In *National Bureau of Economic Research Working Paper Series*: No. 25174.
64. Glindro, E., Subhanij, T., Zhu, H., & Szeto, J. (2011). Determinants of House Prices in Nine Asia Pacific Economies. *International Journal of Central Banking*, *7*, 163-204.
65. Gong, Y., Boelhouwer, P., & de Haan, J. (2016). Interurban house price gradient: Effect of urban hierarchy distance on house prices. *Urban Studies*, *53*(15), 3317-3335. https://doi.org/10.1177/0042098015608090
66. Grebler, L., Blank, D. M., & Winnick, L. (1956). *Capital Formation in Residential Real Estate: Trends and Prospects*. National Bureau of Economic Research.
67. Grum, B., & Govekar, D. (2016). Influence of Macroeconomic Factors on Prices of Real Estate in Various Cultural Environments: Case of Slovenia, Greece, France, Poland and Norway. *Procedia Economics and Finance*, *39*, 597-604. https://doi.org/10.1016/S2212-5671(16)30304-5
68. Halbwachs, M., & Coser, L. A. (1992). *On Collective Memory*. University of Chicago Press.
69. Hayllar, B., Griffin, T., & Edwards, D. (2008). *City Spaces - Tourist Places: Urban*

*Tourism Precincts*. Butterworth-Heinemann. https://doi.org/10.1016/B978-0-7506-8195-7.00019-6

70. Honold, J., Beyer, R., Lakes, T., & van der Meer, E. (2012). Multiple environmental burdens and neighborhood-related health of city residents. *Journal of Environmental Psychology*, *32*(4), 305-317. https://doi.org/10.1016/j.jenvp.2012.05.002
71. Hough, D. E., & Kratz, C. G. (1983). Can "good" architecture meet the market test? *Journal of Urban Economics*, *14*(1), 40-54. https://doi.org/10.1016/0094-1190(83)90028-1
72. Hypostat. (2019). *Hypostat 2019: A Review of Europe's Mortgage and Housing Markets*. European Mortgage Federation.
73. Indahl, U., Næs, T., & Liland, K. (2018). A similarity index for comparing coupled matrices. *Journal of Chemometrics, 32*. https://doi.org/10.1002/cem.3049
74. IVSC. (2021). *International Valuation Standards*. International Valuation Standards Council.
75. Jadevicius, A. (2016). Macro-determinants of the Lithuanian housing market: a test for Granger causality. *Journal of Baltic Studies*, *47*(3), 385-398. https://doi.org/10.1080/01629778.2016.1141105
76. Jamei, E., Rajagopalan, P., Seyedmahmoudian, M., & Jamei, Y. (2016). Review on the impact of urban geometry and pedestrian level greening on outdoor thermal comfort. *Renewable and Sustainable Energy Reviews*, *54*, 1002-1017. https://doi.org/10.1016/j.rser.2015.10.104
77. Kauko, T. (2003). Residential property value and locational externalities: On the complementarity and substitutability of approaches. *Journal of Property Investment & Finance*, *21*(3), 250-270. https://doi.org/10.1108/14635780310481676
78. Ko, Y., & Radke, J. D. (2014). The Effect of Urban Form and Residential Cooling Energy Use in Sacramento, California. *Environment and Planning B: Planning and Design*, *41*(4), 573-593. https://doi.org/10.1068/b12038p
79. Kohn, J., & Bryant, S. (2010). Modeling the U.S. housing bubble: an econometric analysis.
80. Kong, F., Yin, H., & Nakagoshi, N. (2007). Using GIS and landscape metrics in the hedonic price modeling of the amenity value of urban green space: A case study in Jinan City, China. *Landscape and Urban Planning*, *79*, 240-252.
81. Kopits, E., McConnell, V., & Walls, M. (2007). The Trade-off between Private Lots and Public Open Space in Subdivisions at the Urban-Rural Fringe. *American Journal of Agricultural Economics*, *89*(5), 1191-1197.
82. La Rosa, D., Privitera, R., Barbarossa, L., & Greca, P. (2017). Assessing spatial benefits of urban regeneration programs in a highly vulnerable urban context: A case study in Catania, Italy. *Landscape and Urban Planning*, *157*, 180-192. https://doi.org/10.1016/j.landurbplan.2016.05.031
83. Lawlor, E. (2013). The Pedestrian Pound: The Business Case for Better Streets and Places. In. London: Living Streets (The Pedestrians' Association).
84. Lazrak, F., Nijkamp, P., Rietveld, P., & Rouwendal, J. (2014). The market value of cultural heritage in urban areas: an application of spatial hedonic pricing. *Journal of Geographical Systems*, *16*(1), 89-114. https://doi.org/10.1007/s10109-013-0188-1
85. Le Sage, J. P. (1998). *Spatial econometrics*. Unpublished manuscript.

86. Le Sage, J. P., & Pace, R. K. (2009). *Introduction to Spatial Econometrics*. CRC Press.
87. Lee, S., & Lee, B. (2014). The influence of urban form on GHG emissions in the U.S. household sector. *Energy Policy*, *68*, 534-549. https://doi.org/10.1016/j.enpol.2014.01.024
88. Leinberger, C. B. (2007). Financing Walkable Urbane Projects. *Urban Land*, (January).
89. Leinberger, C. B., & Alfonzo, M. (2012). Walk This Way: The Economic Promise of Walkable Places in Metropolitan. In. Washington: Brookings.
90. Levine, J., & Inam, A. (2004). The Market for Transportation-Land Use Integration: Do Developers Want Smarter Growth than Regulations Allow? *Transportation*, *31*(4), 409-427. https://doi.org/10.1023/B:PORT.0000037086.33893.9f
91. Li, H., Wei, Y. D., Yu, Z., & Tian, G. (2016). Amenity, accessibility and housing values in metropolitan USA: A study of Salt Lake County, Utah. *Cities*, *59*, 113-125. https://doi.org/https://doi.org/10.1016/j.cities.2016.07.001
92. Litman, T. (2004). Economic Value of Walkability. *World Transport Policy & Practice*, *10*(1), 5-14. https://doi.org/10.3141/1828-01
93. Macmillan, S. (2006). Added value of good design. *Building Research & Information*, *34*(3), 257-271. https://doi.org/10.1080/09613210600590074
94. Matthews, J., & Turnbull, G. (2007). Neighborhood Street Layout and Property Value: The Interaction of Accessibility and Land Use Mix. *The Journal of Real Estate Finance and Economics*, *35*, 111-141. https://doi.org/10.1007/s11146-007-9035-9
95. Mayer, C.-D., Lorent, J., & Horgan, G. (2011). Exploratory Analysis of Multiple Omics Datasets Using the Adjusted RV Coefficient. *Statistical applications in genetics and molecular biology, 10*, Article 14. https://doi.org/10.2202/1544-6115.1540
96. McConnell, V., & Walls, M. (2005). The Value of Open Space: Evidence from Studies of Nonmarket Benefits.
97. McCord, J., McCord, M., McCluskey, W., Davis, P., McIlhatton, D., & Haran, M. (2014). Effect of public green space on residential property values in Belfast metropolitan area. *Journal of Financial Management of Property and Construction*, *19*. https://doi.org/10.1108/JFMPC-04-2013-0008
98. McIndoe, G., Chapman, R., McDonald, C., Holden, G., Howden-Chapman, P., & Sharpin, A. (2005). The Value of Urban Design: The Economic, Environmental and Social Benefits of Urban Design. In. Wellington: Ministry for the Environment.
99. MFRL. (2020). *Turto ir verslo vertinimo metodika* [The Methodology of Property and Business Valuation] (Consolidated ed.). Ministry of Finance of the Republic of Lithuania.
100. Nakamura, K., & Hayashi, Y. (2013). Strategies and instruments for low-carbon urban transport: An international review on trends and effects. *Transport Policy*, *29*, 264-274. https://doi.org/10.1016/j.tranpol.2012.07.003
101. Nasdaq. (2020). *Nasdaq Baltic*. https://www.nasdaqbaltic.com/
102. Nase, I., Berry, J., & Adair, A. (2015). Urban design quality and real estate value: in search of a methodological framework. *Journal of Urban Design*, *20*(5), 563-581. https://doi.org/10.1080/13574809.2015.1071657
103. Nase, I., Berry, J., & Adair, A. (2016). Impact of quality-led design on real estate value: a spatiotemporal analysis of city centre apartments. *Journal of Property Research*, *33*(4), 309-331. https://doi.org/10.1080/09599916.2016.1258588

104. Navickas, V., & Skripkiūnas, T. (2020). Macro dynamics of the real estate market value: Temporal effects. *Torun International Studies*, *1*, 119. https://doi.org/10.12775/TIS.2020.009

105. Navickas, V., & Skripkiūnas, T. (2020). Microeconomics of architecture: between market and public. Vadyba = Journal of management, 36(2), 85-90.

106. Navickas, V., Skripkiūnas, T., Tanaś, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: A methodological framework. *Journal of International Studies*, *13*(4), 38-53. https://doi.org/10.14254/2071-8330.2020/13-4/3

107. Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197-210. doi:10.14254/2071-8330.2022/5-1/13

108. Nilsson, P. (2014). Natural amenities in urban space – A geographically weighted regression approach. *Landscape and Urban Planning*, *121*, 45-54. https://doi.org/https://doi.org/10.1016/j.landurbplan.2013.08.017

109. NYCDT. (2012a). *Measuring the Street: New Metrics for 21st Century Streets*. New York City Department of Transportation.

110. NYCDT. (2012b). *The Economic Benefits of Sustainable Streets*. New York City Department of Transportation.

111. Ober-Haus. (2020). *Lithuanian apartment price index (OBHI)*. Ober-Haus Real Estate Advisors. https://www.ober-haus.lt/en/rinkos_apzvalgos/lithuanian-price-index/

112. Odean, T. (1999). Do Investors Trade Too Much? *American Economic Review*, *89*(5), 1279-1298.

113. OGRL. (2015). *Nekilnojamojo turto vertinimo taisyklės* [The Rules of Real Estate Valuation] (Consolidated ed.). Office of the Government of the Republic of Lithuania.

114. Pilinkienė, V., Stundžienė, A., Stankevičius, E., & Grybauskas, A. (2020). Nekilnojamojo turto rinkos pokyčiai ekonominio šoko kontekste: Lietuvos atvejis. In (pp. 174). Kaunas University of Technology: Technika.

115. Rashkin, S. (2010). *Retooling the U.S. Housing Industry: How It Got Here, Why It's Broken, How To Fix It*. Cengage Learning.

116. Ratti, C., Baker, N., & Steemers, K. (2005). Energy consumption and urban texture. *Energy and Buildings*, *37*(7), 762-776. https://doi.org/10.1016/j.enbuild.2004.10.010

117. RICS. (2016). *RICS Valuation – Global Standards*. Royal Institution of Chartered Surveyors.

118. RICS. (2019). *RICS Valuation – Global Standards*. Royal Institution of Chartered Surveyors.

119. Robert, P., & Escoufier, Y. (1976). A Unifying Tool for Linear Multivariate Statistical Methods: The RV- Coefficient. *Journal of the Royal Statistical Society. Series C (Applied Statistics), 25*(3), 257-265. https://doi.org/10.2307/2347233

120. Roehner, B. M. (1999). Spatial analysis of real estate price bubbles: Paris, 1984–1993. *Regional Science and Urban Economics*, *29*(1), 73-88. https://doi.org/https://doi.org/10.1016/S0166-0462(98)00012-X

121. Rong, H., Yang, J., Kang, M., & Chegut, A. (2020). The Value of Design in Real Estate Asset Pricing. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3582530

122. Rosser, J. B. (1991). *From Catastrophe to Chaos: A General Theory of Economic Discontinuities*. Springer US.

123. Rudokas, K., Landauskas, M., Viliūnienė, O., & Gražulevičiūtė-Vileniškė, I. (2019). Hedonic analysis of housing prices and development in Kaunas: heritage aspect. *Environmental research, engineering and management*, *75*(2), 15-27. https://doi.org/10.5755/j01.erem.75.2.22823

124. Ryan, B., & Weber, R. (2007). Valuing New Development in Distressed Urban Neighborhoods. *Journal of the American Planning Association*, *73*, 100-111. https://doi.org/10.1080/01944360708976139

125. Saunders, E. M. (1993). Stock Prices and Wall Street Weather. *American Economic Review*, *83*(5), 1337-1345.

126. Scerri, M., Edwards, D., & Foley, C. (2019). Design, architecture and the value to tourism. *Tourism Economics*, *25*(5), 695-710. https://doi.org/10.1177/1354816618802107

127. SECR. (2021). *Vilniaus miesto savivaldybės teritorijos nekilnojamojo turto masinio vertinimo ataskaita* [The Report on Real Estate Mass Valuation of Vilnius City Municipality]. State Enterprise Centre of Registers.

128. Shefrin, H. M., & Statman, M. (1984). Explaining investor preference for cash dividends. *Journal of Financial Economics*, *13*(2), 253-282.

129. Shiller, R. J. (2000). Measuring Bubble Expectations and Investor Confidence. *Journal of Psychology and Financial Markets*, *1*(1), 49-60. https://doi.org/10.1207/S15327760JPFM0101_05

130. Shiller, R. J. (2002). Bubbles, Human Judgment, and Expert Opinion. *Financial Analysts Journal*, *58*(3), 18-26. https://doi.org/10.2469/faj.v58.n3.2535

131. Shiller, R. J. (2005). *Irrational Exuberance* (2nd Edition ed.). Princeton University Press.

132. Shiller, R. J. (2007). Understanding Recent Trends in House Prices and Home Ownership. *National Bureau of Economic Research Working Paper Series*, *No. 13553*. https://doi.org/10.3386/w13553

133. Shiller, R. J. (2014). Speculative Asset Prices. *The American Economic Review*, *104*(6), 1486-1517.

134. Sibson, R. (1978). Studies in the Robustness of Multidimensional Scaling: Procrustes Statistics. *Journal of the Royal Statistical Society. Series B (Methodological), 40*(2), 234-238.

135. Skripkiūnas, T., & Navickas, V. (2023). Architectural factors influencing a housing market value: A theoretical framework. *Real estate management and valuation, 31*(1), 25-35. doi:10.2478/remav-2023-0003

136. Smilde, A., Kiers, H., Bijlsma, S., Rubingh, C., & Erk, M. (2009). Matrix correlations for high-dimensional data: The modified RV-coefficient. *Bioinformatics (Oxford, England), 25*, 401-405. https://doi.org/10.1093/bioinformatics/btn634

137. Smith, D. (2010). Valuing housing and green spaces: Understanding local amenities, the built environment and house prices in London.

138. Smith, M., & Smith, G. (2006). Bubble, Bubble, Where's the Housing Bubble? *Brookings Papers on Economic Activity*, *73*. https://doi.org/10.1353/eca.2006.0019

139. Song, Y., & Knaap, G.-J. (2004). Measuring the effects of mixed land uses on housing values. *Regional Science and Urban Economics*, *34*(6), 663-680.

140. Spencer, N. C., & Winch, G. (2002). *How Buildings Add Value for Clients*. Thomas Telford.

141. SR. (2010). *Development Layout*. Savills Research.

142. SR. (2016). *Development: The Value of Placemaking*. Savills Research.

143. SRL. (2017). *Lietuvos Respublikos turto ir verslo vertinimo pagrindų įstatymas* [The Law on the Fundamentals of Property and Business Valuation of the Republic of Lithuania] (Consolidated ed.). Seimas of the Republic of Lithuania.

144. Stamou, M., Mimis, A., & Rovolis, A. (2017). House price determinants in Athens: a spatial econometric approach. *Journal of Property Research*, *34*(4), 269-284. https://doi.org/10.1080/09599916.2017.1400575

145. Sun, Q., Tang, Y., & Yang, A. (2017). The Spatial Statistics Analysis of Housing Market Bubbles. *Journal of Systems Science and Information*, *5*(3), 250-266.

146. Sutton, G. D. (2002). Explaining changes in house prices. *BIS Quarterly Review*, 46-55.

147. Thorsnes, P. (2000). Internalizing Neighborhood Externalities: The Effect of Subdivision Size and Zoning on Residential Lot Prices. *Journal of Urban Economics*, *48*, 397-418. https://doi.org/10.1006/juec.2000.2173

148. Trojanek, R. (2016). The Impact of Green Areas on Dwelling Prices: the Case of Poznań City. *Entrepreneurial Business and Economics Review, 4*(2), 27–35. https://doi.org/10.15678/EBER.2016.040203

149. Trojanek, R., & Gluszak, M. (2018). Spatial and time effect of subway on property prices. *Journal of Housing and the Built Environment*, *33*(2), 359-384. https://doi.org/10.1007/s10901-017-9569-y

150. Trojanek, R., Gluszak, M., & Tanas, J. (2018). The Effect of Urban Green Spaces on House Prices in Warsaw [Article]. *International Journal of Strategic Property Management*, *22*(5), 358-371. https://doi.org/10.3846/ijspm.2018.5220

151. Trojanek, R., & Huderek-Glapska, S. (2018). Measuring the noise cost of aviation – The association between the Limited Use Area around Warsaw Chopin Airport and property values. *Journal of Air Transport Management*, *67*, 103-114. https://doi.org/https://doi.org/10.1016/j.jairtraman.2017.12.002

152. Trojanek, R., Tanas, J., & Trojanek, M. (2019). The effect of perpetual usufruct on single- family house prices in Poznań. *Journal of International Studies, 12*(3), 212–221. https://doi.org/10.14254/2071-8330.2019/12-3/17

153. Tu, C. C., & Eppli, M. J. (1999). Valuing New Urbanism: The Case of Kentlands. *Real Estate Economics*, *27*(3), 425-451. https://doi.org/https://doi.org/10.1111/1540-6229.00779

154. Tupenaite, L., Kanapeckiene, L., & Naimaviciene, J. (2017). Determinants of Housing Market Fluctuations: Case Study of Lithuania. *Procedia Engineering*, *172*, 1169-1175. https://doi.org/10.1016/j.proeng.2017.02.136

155. UN. (2013). *Streets as Public Spaces and Drivers of Urban Prosperity*. UN Habitat.

156. Vandell, K. D., & Lane, J. S. (1989). The Economics of Architecture and Urban Design: Some Preliminary Findings. *Real Estate Economics*, *17*(2), 235-260. https://doi.org/10.1111/1540-6229.00489

157. Varian, H. R. (2006). *Intermediate microeconomics: a modern approach* (7th ed. ed.). Norton.

158. Whitbread, M. (1978). Two Trade-off Experiments to Evaluate the Quality of Residential Environments. *Urban Studies*, *15*(2), 149-166. https://doi.org/10.1080/713702338

159. Wiedemer, D., Wiedemer, R., & Spitzer, C. (2009). *Aftershock: Protecting Yourself and Profit in the Next Global Financial Meltdown*. Wiley.

160. Wilhelmsson, M. (2002). Spatial Models in Real Estate Economics. *Housing, Theory and Society*, *19*(2), 92-101. https://doi.org/10.1080/140360902760385646

161. Wilhelmsson, M. (2004). A method to derive housing sub-markets and reduce spatial dependency. *Property Management*, *22*(4), 276-288. https://doi.org/10.1108/02637470410558143

162. Wolf, K. L. (2007). City Trees and Property Values. *Arborist News*, *16*(4), 34-36.

163. Worpole, K. (2000). *The Value of Architecture: Design, Economy and the Architectural Imagination*. Royal Institute of British Architects.

164. Yang, H. J., Song, J., & Choi, M. J. (2016). Measuring the Externality Effects of Commercial Land Use on Residential Land Value: A Case Study of Seoul. *Sustainability*, *8*(5), 432.

165. Yao, R., & Zhang, H. H. (2005). Optimal Consumption and Portfolio Choices with Risky Housing and Borrowing Constraints. *Review of Financial Studies*, *18*(1), 197-239.

166. Zapata Diomedi, B., Mantilla Herrera, A., & Veerman, J. (2016). The effects of built environment attributes on physical activity-related health and health care costs outcomes in Australia. *Health & Place*, *42*, 19-29. https://doi.org/10.1016/j.healthplace.2016.08.010

167. Zhan, W., & Chui, T. F. M. (2016). Evaluating the life cycle net benefit of low impact development in a city. *Urban Forestry and Urban Greening*, *20*, 295. https://doi.org/10.1016/j.ufug.2016.09.006

168. Zhang, B., Xie, G., Bin, X. I. A., & Canqing, Z. (2012). The Effects of Public Green Spaces on Residential Property Value in Beijing. *Journal of Resources and Ecology*, *3*. https://doi.org/10.5814/j.issn.1674-764x.2012.03.007

169. Zhou, J., Lin, J., Cui, S., Qiu, Q., & Zhao, Q. (2013). Exploring the relationship between urban transportation energy consumption and transition of settlement morphology: A case study on Xiamen Island, China. *Habitat International*, *37*, 70-79. https://doi.org/https://doi.org/10.1016/j.habitatint.2011.12.008

170. Zietz, J., Zietz, E. N., & Sirmans, G. S. (2008). Determinants of House Prices: A Quantile Regression Approach. *The Journal of Real Estate Finance and Economics*, *37*(4), 317-333. https://doi.org/10.1007/s11146-007-9053-7

## LIST OF PUBLICATIONS

### Articles

1. Skripkiūnas, T., & Navickas, V. (2023). Architectural factors influencing a housing market value: a theoretical framework. *Real estate management and valuation, 31*(1), 25–35. doi:10.2478/remav-2023-0003
2. Navickas, V., Skripkiūnas, T., & Vida, I. (2022). The identification of spatial bubbles in a real estate market. *Journal of international studies, 15*(1), 197–210. doi:10.14254/2071-8330.2022/5-1/13
3. Navickas, V., Skripkiūnas, T., Tanas, J., & Trojanek, M. (2020). The influence of architecture on real estate market value: a methodological framework. *Journal of international studies, 13*(4), 38–53. doi:10.14254/2071-8330.2020/13-4/3
4. Navickas, V., & Skripkiūnas, T. (2020). Macro dynamics of the real estate market value: temporal effects. *Torun international studies, 1*(13), 119–129. doi:10.12775/TIS.2020.009
5. Navickas, V., & Skripkiūnas, T. (2020). Microeconomics of architecture: between market and public. *Vadyba = Journal of management, 36*(2), 85–90

### Conference proceedings

6. Skripkiūnas, T. ir Navickas, V. (2023). The architectural factors and the unexplained variance in the housing market. In *12th international conference on applied economics "Contemporary issues in economy", Poland 29–30 June, 2023* (pp. 134–134). Olsztyn: Instytut Badań Gospodarczych.
7. Skripkiūnas, T., & Navickas, V. (2022). The influence of urban design and planning factors on the spatial dependency of real estate market value. In *Proceedings of the 6th international conference on research in business, management and economics (ICRBME), 3–5 November, 2022, Vienna, Austria* (pp. 1–1). Vienna: Diamond Scientific Publishing.
8. Skripkiūnas, T., & Navickas, V. (2021). Real estate market value and its spatial dependency at city scale. In *14th international scientific-methodical-practical conference on sustainable regional development: Economics, management, law and technology opportunities 2021 Klaipeda, Lithuania, 1–2 October, 2021: abstract book* (pp. 43–43). Gödöllő: Hungarian University of Agriculture and Life Science.
9. Navickas, M., & Skripkiūnas, T. (2020). Strategic planning: balance between public space, maritime sector and its impact on shadow economy. In *III International science conference SER 2020: "New trends and best practices in socioeconomic research", September 17–19, 2020, Igalo (Herceg Novi), Montenegro* (pp. 77–77). Podgorica: Economic Laboratory for Transition Research.

### Conferences

1. Skripkiūnas, T., Navickas, V. (2023). The Architectural Factors and the Unexplained Variance in the Housing Market. The 12th International

Conference on Applied Economics “Contemporary Issues in Economy”. Olsztyn, Poland, 29–30 June, 2023.
2. Skripkiūnas, T., Navickas, V. (2022). The Features of Urban Design and Planning Factors in the Housing Sector. The 5th International Scientific Conference "Challenges, Trends and Inspirations within the Labor Market". Trenčin, Slovakia, 10t–11 November, 2022.
3. Skripkiūnas, T., Navickas, V. (2022). The Influence of Urban Design and Planning Factors on the Spatial Dependency of Real Estate Market Value. The 6th International Conference on Research in Business, Management and Economics (ICRBME). Vienna, Austria, 3–5 November, 2022.
4. Skripkiūnas, T,; Navickas, V. (2021). Spatial Dependency of Apartment Market Value inside a City. The 5th International Scientific Conference "Challenges, Trends and Inspirations within the Labor Market". Trenčin, Slovakia, 11th November, 2021.
5. Skripkiūnas, T,; Navickas, V. (2021).Real Estate Market Value and Its Spatial Dependency at City Scale. The International Scientific Conference "Sustainable Regional Development: Economical, Management, Law and Technological Possibilities 2021“. Klaipėda, Lithuania, 1st October, 2021.
6. Navickas, M.; Skripkiūnas, T. (2020). Strategic Planning: Balance Between Public Space, Maritime Sector and Its Impact on Shadow Economy. The International Scientific Conference "New Trends and Best Practices in Socioeconomic Research (SER) 2020". Igalo, Herceg Novi, Montenegro, 17–19 September, 2020.
7. Navickas, V.; Skripkiūnas, T. (2019). Sustainable Architectural Solutions Impact on Competitiveness in Context of Industry 4.0. The International Scientific Conference “The Impact of Industry 4.0 on Job Creation”. Trenčin, Slovakia, 21st November, 2019.

## CURRICULUM VITAE

### Contact

tomas.skripkiunas@gmail.com
+37061270887

### Education

2019-10–present, Doctoral studies, Kaunas University of Technology, School of Economics and Business, Kaunas, Lithuania
2012-09–2014-09, Master of Architecture, Vilnius Gediminas Technical University, Faculty of Architecture, Vilnius, Lithuania
2008-09–2012-09, Bachelor of Architecture, Vilnius Gediminas Technical University, Faculty of Architecture, Vilnius, Lithuania

### Work experience

2022-02–present, Co-Founder, Syntropy Platforms, London, the United Kingdom
2018-12–present, Architect, Self-employed
2016-08–2018-05, Architect, Senior Architect (from 2017-02), DO architects, Vilnius, Lithuania
2014-04–2016-08, Architect, Eventus Pro, Vilnius, Lithuania
2011-07–2011-08, Internship, Monteforte Architectural Studio, Ocean Township, NJ, USA
2011-05–2011-07, Internship, Audrius Ambrasas Architects, Vilnius, Lithuania

### Scientific interest

Real estate, asset pricing

UDK 332.6/.7+351.778.56+332.85:72](043.3)

SL 344. 2023-08-31, 15,25 leidyb. apsk. l. Tiražas 14 egz. Užsakymas 153.
Išleido Kauno technologijos universitetas, K. Donelaičio g. 73, 44249 Kaunas
Spausdino leidyklos „Technologija“ spaustuvė, Studentų g. 54, 51424 Kaunas