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ARCHITECTURAL FACTORS INFLUENCING A HOUSING MARKET VALUE: A THEORETICAL FRAMEWORK

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ABSTRACT

A housing price, not considering its change over time, is widely determined by hedonic properties. This is common in literature; however, there is a significant part of a price, the so-called unexplained variance, that is not captured by hedonic models. The scientific problem of this research is how to classify and visualize architectural factors that might have an influence on the market value of a dwelling. The object of the research are architectural factors in a housing market value analysis and the aim of research is to describe the theoretical framework that defines the structure and scope of architectural variables influencing a housing market value. Not all architectural factors described in the literature review are equal in terms of scale, measurability, public or private context, aesthetic or functional priority. A systematic approach would be to classify architectural factors as a matrix of built environment properties. Two orthogonal dimensions can be identified: architectural factors spanning from non-design (functional, utilitarian) to design (abstract, unexplained) and factors spanning from architectural design (private) to urban design (public). A multidimensional and complex system of architectural variables influencing a housing market value exists. Understanding this system is crucial for a housing development to succeed.

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1. Introduction

The price of housing, not considering it's change over time, is widely determined by hedonic properties. This is common in literature, however, there is a significant part of a price, the so-called unexplained variance, that is not captured by hedonic models. Professional valuation techniques solve this problem by using nearby transaction data to determine a housing market value, but this does not suggest any economic intuition behind the variance of a housing market value. Many research papers rely on hedonic models to control for the heterogeneity of housing units. However, if we ask the question of whether hedonic properties fully explain variance in housing market value between different housing units, the answer would raise discussion. Theoretically architectural factors should be included, however, a scientific problem appears because there is no theoretical framework and economic intuition behind those variables influencing a housing market value. There are studies that include selected examples of such architectural factors to improve the accuracy of a housing price analysis but there is no understanding of the total amount and classification of those variables. The scientific problem of this research is how to classify and visualize architectural factors that might have an influence on housing market value. The object of research are architectural factors in a housing market value analysis and the aim of the research is to describe the theoretical framework that defines the structure and scope of architectural variables influencing housing market value. The

novelty of this research lies in the classification, systematization and visualization of selected factors that are presented in the research and discussion part. Such a theoretical framework of architectural factors influencing housing market value can help to understand the economic intuition behind these factors. The reasoning behind housing pricing strategies demonstrates the practical significance of this research suggesting a wider scope of factors that might have an impact on housing market value. This might result in improved hedonic models and advance us towards a universal model for the individual valuation of real estate. Mass appraisal models could also be improved. The research also tries to connect two fields of scientific research – the determinants of market value in real estate economics and the economic outcomes of the built environment in architecture. This research looks at the theoretical analysis not considering the ability to measure architectural factors. This research also introduces the field of architecture in the widest sense – from urban planning, urban design to individual building architectural design, interior design. From the theoretical framework constructed, we can say that architectural factors are not well defined and the boundaries of such factors are blurred in various dimensions. A multidimensional and complex system of architectural factors exists, which is crucial for real estate development to succeed.

2. Literature review

In this study three main areas of literature are reviewed: (1) the documentation for real estate appraisal; (2) scientific literature on the determinants of real estate market value; (3) scientific literature on the value built environment generates. The aim of this review is to understand the range of architectural factors and variables in order to better define and classify them. Although the fundamental variance of real estate 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 real estate appraisal. There are three main valuation approaches: (1) market approach; (2) income approach; (3) cost approach. Other approaches defined in International standards and European standards or combination of approaches above can also be used (Seimas of the Republic of Lithuania, 2017; Ministry of Finance of the Republic of Lithuania, 2020; IVSC, 2021, p. 111). The concept of having these different approaches tries to solve the fundamental question of why buildings with similar cost, taking into account the income 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 different approaches may indicate the unexplained variance that assessors deal with.

This research looks at architectural factors across various approaches to real estate market value. (1) The market approach compares nearby transactions, however, the main problem of real estate not being homogenous appears, and therefore 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 real estate, the ability to control for architectural factors could potentially improve the market approach. Numerous variables could be included if granular enough data existed. (2) The income approach calculates the potential income, therefore, 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. Architectural factors could be crucial in the 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 location. Depreciation should consider the physical and economic lives of the asset (IVSC, 2021, p. 52). While physical depreciation is relatively easy to measure, economic depreciation is more abstract and integrates socioeconomic changes about how people are using the built environment. Also, correction for location is crucial and must rely on exogenous coefficients from 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 economic value, location and many potential architectural factors. Architectural factors can act similarly to economic depreciation – changing conditions and market trends over time or across space can strongly influence market value.

Mass appraisal is a good example of structuring the main factors influencing real estate market value.

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Taking the Lithuanian example, mass appraisal of real estate is performed in stages, i.e.: the market approach is used to create value maps and zones. Those value zones are essentially spatial bubbles of real estate market value on a country or city scale. According to those value zones and other known factors, models with coefficients are created for specific groups of buildings (Office of the Government of the Republic of Lithuania, 2015). Buildings are grouped according to their function. Core characteristics are included in those models: location, function, physical properties like total floor area, number of rooms, year of construction and others based on information available in the real estate registry, mechanical equipment, land value coefficient, other known factors (State Enterprise Centre of Registers, 2021, p. 70). The important thing here 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 individual building architectural quality wise.

The cost approach is also used to verify the market approach in mass appraisal. A sequence of values is calculated using the cost approach: (1) the construction cost of real estate; (2) the replacement cost of real estate – the construction cost is adjusted for the depreciation percent for all years in use; (3) average market value – the replacement cost of 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 real estate using the cost approach. A location correction coefficient represents the ratio between market value and replacement cost in a particular value zone (Office of the Government of the Republic of Lithuania, 2015). This is done to eliminate the unexplained variance which defines the scientific problem of this research.

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

(1) Individual building level non-design factors are very much straightforward – these are the basic properties of real estate:

(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 terrace; 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 & Lahr, 2005; Buitelaar & Schilder, 2017; Asabere et al., 1989; Vandell & 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 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 & Schilder, 2017; Asabere et al., 1989; Fuerst et al., 2011; Stamou et al., 2017; Glaeser et al., 2018; Gat, 1998; Rudokas et al., 2019).

We move from the above-listed non-design factors towards architectural design factors. (2) Individual building level architectural design factors:

(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; color and texture of surface materials; quality of surface materials; differences in configuration or shape of the building,

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massing, and fenestration, including the presence or absence of site amenities); quality of components (elevator/ lobby/ finishes, etc.) (Glaeser et al., 2018; Vandell & 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 & Lahr, 2005; Buitelaar & 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 standard uniform housing projects); completeness of architectural appearance; altered building (Rudokas et al., 2019; Been et al., 2016; Coulson & Lahr, 2005).

The next step would go to larger scale (3) neighborhood 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 subcentral city; travel time to subcentral 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 & Lane, 1989; Stamou et al., 2017; Trojanek et al., 2018; Czembrowski & Kronenberg, 2016; Trojanek & Huderek-Glapska, 2018; Trojanek & Gluszak, 2018).

(4) Neighborhood 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 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 & 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 & Lahr, 2005; Been et al., 2016).

Variables representing architectural factors can be used as absolute values, intervals of absolute values, dummies and other. Many selected research studies in literature review have controls for location or spatial dependency. This is not primarily an architectural factor but is core ingredient because location is inevitably associated with architectural surroundings. Most common measures are latitude and longitude, neighborhood or other spatial fixed effects used for spatial econometric models (Glaeser et al., 2018; Stamou et al., 2017; Buitelaar & Shilder, 2017). An extra layer of spatial dependency factors could be added controlling for adjacent properties – value spillovers. Many studies in the literature review also have controls for temporal effects if data extends over a significant amount of time during which the price has changed because of macroeconomic or other external factors (Glaeser et al., 2018; Nase et al., 2016; Buitelaar & 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 & Lahr, 2005). Some selected studies in the literature review include the pairs of interactions of selected variables.

The limitations of this study include land prices (Prayitno, 2021). Land prices are highly associated with location and neighborhood factors; however, this dichotomic relationship of land prices and these variables would require a separate study. Another limitation arises from the supply and demand perspective. Demand driven factors, like consumer

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preferences (Tanaś et al., 2019) or available financing (Kovacs & Pasztor, 2021), are not considered in this study.

Scientific literature on the value 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. 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 section goes thorough place quality factors that result in specified groups of economic outcomes.

(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 a landscape with trees, forests, residential development with landscape integration or open landscapes, presence of parks and plazas, amount of natural open space (Anderson & Cordell, 1988; Wolf, 2007; Li et al., 2016; Nilsson, 2014; Correll et at., 1978; CABE, 2005; Anderson & West, 2006; Kong et al., 2007; Biao et al., 2012; McCord et al., 2014; Smith, 2010; Dewaelheyns et al., 2014; McConnell & 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 & Ferreira, 2010; Savills, 2010; Savills, 2016; Song & Knaap, 2004; Matthews & Turnbull, 2007; CABE, 2003; Tu & Eppi, 1999; Ahlfeld & Mastro, 2012; Thorsnes, 2000; Bowes & Ihlanfeldt, 2001; Bartholomew & Ewing, 2011; Levine & Inam, 2004; Yang et al., 2016; Cervero & Duncan, 2004; Whitbread, 1978).

(2) Influence on economic value is less directly related to real estate 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 Habitat, 2013; Lawlor, 2013; Carmona, 2015; CABE, 2007; New York City Department of Transportation, 2012a, 2012b; Carmona et al., 2018; CBRE, 2017).

(3) Influence on economic development is even less directly related to real estate 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; English Heritage, 2002; Ahlfeldt et al., 2012; Spencer & Winch, 2002; Carmona et al., 2001; McIndoe et al., 2005; La Rosa et al., 2017; Ryan & Weber, 2007).

(4) Some place quality factors have an influence on public spending: walkability, distance to public transport, passive security, good street lighting, good maintenance (Zapata-Diomedi et al., 2016; Litman, 2003; Leinberger & Alfonzo, 2012; Ewing et al., 2009; Glaeser & Gottlieb, 2008; CABE, 2009; Zhan & Chui, 2016; Simmons et al., 2006).

These architectural factors or place quality factors are primarily orientated towards design, whether regarding the individual building or urban structure. Reflecting our research problem, these factors represent design properties that might add value to real estate directly to its market value or through other economic mechanisms. These architectural factors suggest economic intuition behind variance of market value, which professional assessors can capture using the market approach. Including these factors in hedonic models could be a step forward towards a universal model 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. 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 real estate market value. While architectural factors from scientific literature on the determinants of real estate market value have a more direct influence on property market value, the other part of architectural variables found in literature on the value built environment generates have positive public outcomes that therefore result in higher market value. A direct influence as well as indirect influence on market value exists (Navickas et al., 2020). The complex mechanism of value transfers between architecture, the built environment, public policy dimensions and real estate market value exists.

3. Research and discussion

This research builds on hedonic models from selected literature. It is clear that not all architectural factors described in literature review are equal in terms of scale, measurability, public or private context, aesthetic or functional priority. For example, size is much more commonly used and easy to measure

compared to architectural style, which is difficult to understand and hard to identify. Also, size is something that rises from client/ necessity rather than architectural vision and is not primarily in control of an architect, whereas architectural style is more abstract and emotionally binding. We select the size of a housing object because of objective reasons, while style is selected because of subjective preference. The primary classification of architectural factors is suggested in Figure 1.

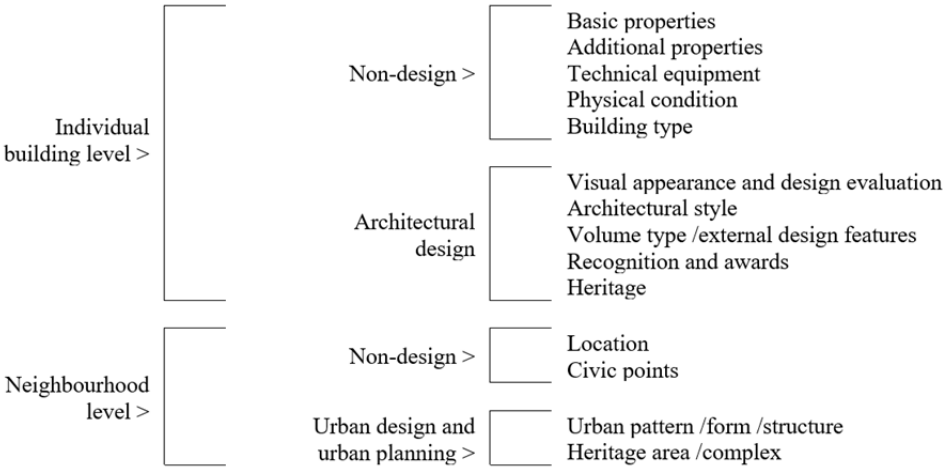

Fig. 1.The classification of architectural variables. *Source*: own study.

This creates a theoretical basis for creating real estate market value models: market value is equal to control variables for non-design (building level non-design and location/ neighborhood level non-design), unexplained variance (architectural design and urban design) and residual variance. The concept of this model comes from cost being dependent on building level non-design factors and partly architectural design factors; also, market value being equal to cost adjusted by market correction. That market correction is constructed of location/ neighborhood factors and unexplained factors (architectural and urban design), and other unknown factors, like consumer irrationality and others. In the case of newly constructed partly finished housing at a fixed moment in time:

$$P_i = C_i * \beta_i \quad (1)$$

P_i – market value; C_i – cost; β_i – market correction (location /neighbourhood factors and unexplained factors (architectural and urban design), and other unknown factors like consumer irrationality);

$$C_i = c(A1_i, X1_i') \quad (2)$$

C_i – cost; $A1_i$ – building level non-design factors; $X1_i'$– partly architectural design factors.

Therefore:

$$P_i = c(A1_i, A2_i, X1_i, X2_i) \quad (3)$$

P_i – market value; $A1_i$ – controls for building level non-design factors; $A2_i$ – controls for location /neighbourhood level non-design factors; $X1_i$ – architectural design factors; $X2_i$ – urban design factors.

The main idea behind these formulas is to control for non-design factors and add design factors to hedonic models. Although, in the Lithuanian case, it is common to buy an apartment with a piece of land that it is built on, land prices are not considered in the context of this research.

The hierarchy of architectural factors is complex – the lower scale factors are the same ones that create higher scale factors (Figure 2). 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 combination of individual buildings creates unique urban properties. The crucial idea here is that individual building architectural design properties, acting together as a combination, create urban design properties.

The visualization of architectural factors across two dimensions has been presented in Figure 3. Two main dimensions of architectural factors are identified: (1) factors spanning from architectural design /interior design /private to urban planning and urban design /public (from bottom to top); (2) factors spanning from non-design /functional /utilitarian to design /abstract /unexplained (from left to right). A gradient /matrix of variables exists rather than strict groups.

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The first dimension resembles aesthetics and functionalism both of them interactive with design distinguished by Vandell & Lane (1989). The second dimension resembles architecture (object) and urban design (the structure object is situated in) as intrinsic and extrinsic attributes respectively also explained by Vandell and Lane (1989). Similarly, Vandell & Lane (1989) wrote that every structure possesses design and non-design characteristics. Non-design characteristics are selected by consumers and there could be numerous amounts of design configurations to achieve those characteristics. Those different configurations can create different amounts of value.

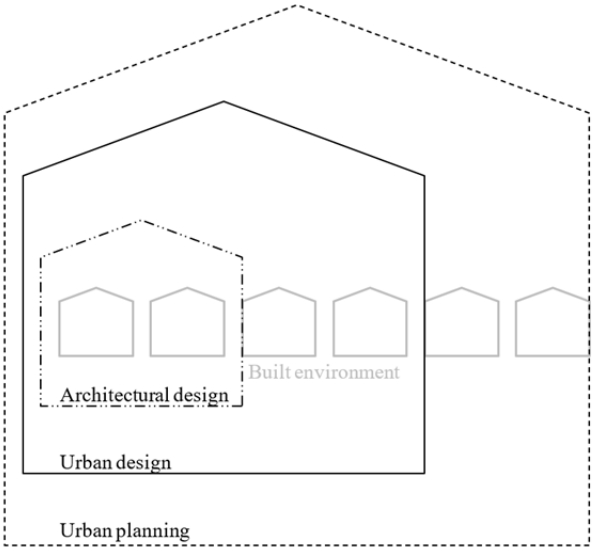

Fig. 2.The structural hierarchy of architectural factors. *Source*: own study.

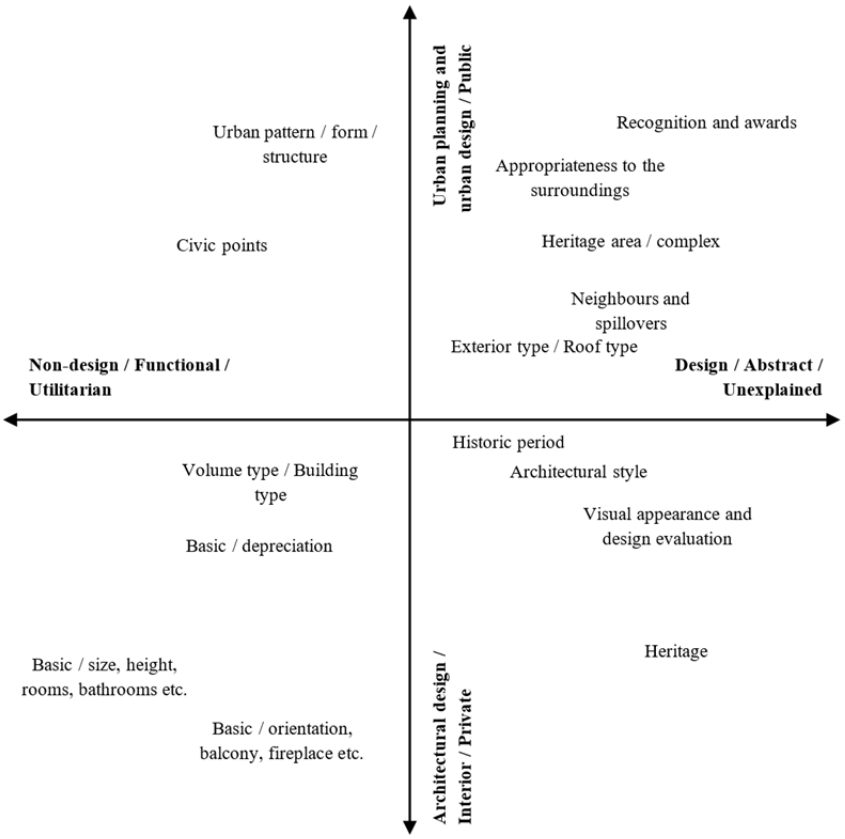

Fig. 3. Dimensions of architectural factors. *Source*: own study.

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The concept of architectural factors is positioned between basic hedonic properties of real estate and the unexplained part of real estate market value. Furthermore, on the other dimension, architectural factors are widely spread between private/ market and public/ non-market realm. Therefore, some of the variance created by architectural factors is already captured by hedonic models. The least explored area of architectural factors is in the upper right quarter of Figure 3, comprising design/ abstract/ unexplained and urban planning and urban design /public. If we consider market value from the product perspective, this quarter is what drives market value further from fundamentals and creates market bubbles. The problem with those abstract urban design architectural factors is that there is no data or the fact that it is hard to measure those factors.

Architectural factors have an influence through various economic mechanisms – microeconomic factors, supply and demand models, hedonic models, public policy factors or spatial dependency. The economic mechanism of architectural factors influencing housing market value has been presented in Figure 4.

Microeconomic factors. A better built environment would surely create a better microeconomic environment, and therefore supply and demand models would be altered and would influence the housing market value. While adding *architectural factors* to the model would presumably increase the accuracy and objectiveness of the housing market value, *supply and demand factors* should also be included because of consumer segmentation, irrationality from the consumer perspective. Some properties of housing might have an unevenly weighted effect on price, which is subjective and might be irrational. However, the question remains how much supply and demand is influenced directly by microeconomic factors and how much by architectural factors.

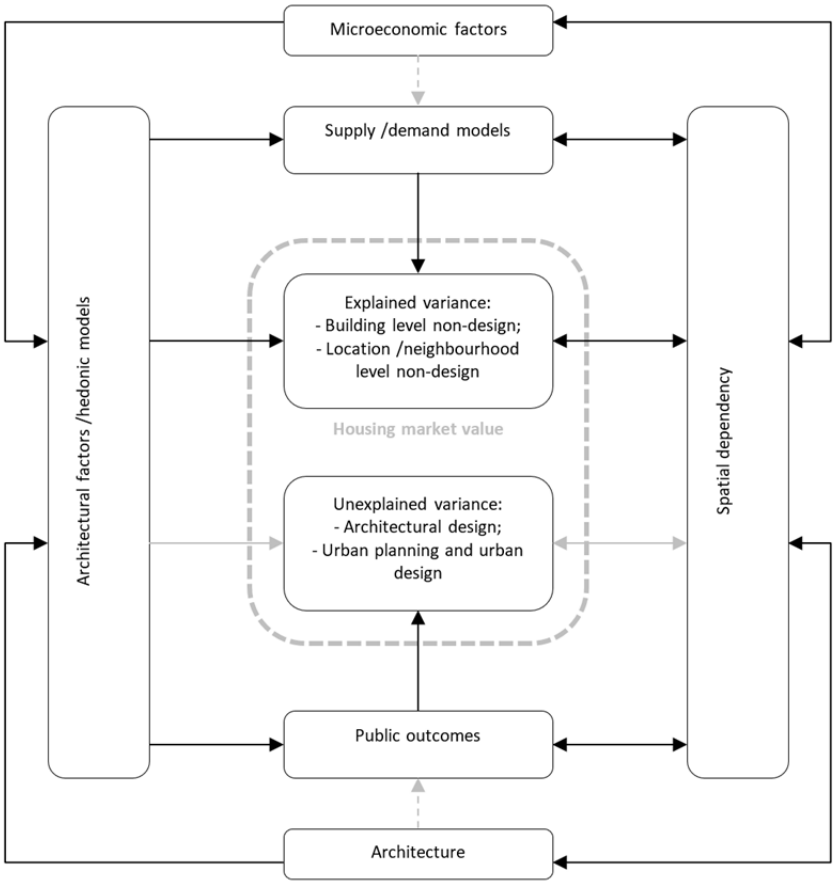

Fig. 4.The economic mechanism of architectural factors influencing housing market value. *Source*: own study.

Spatial dependency is rather ambiguous. Spatial dependency is an object of reverse causality. Firstly, it is created and defined by architectural factors and/or variance of market value across space. However, it is difficult to explain this as a causal effect because spatial dependency becomes an architectural factor itself in many research studies.

Market value is divided into explained and

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unexplained variance. We can explain supply and demand models, significant part of architectural factors, most hedonic non-design properties and spatial dependency. Unexplained variance could be explained by public outcomes, design/ abstract architectural factors, deeper understanding of spatial dependency models. *Public outcomes*, similarly to supply and demand, become a mechanism that might leverage the translation of value from architectural factors to housing market value.

5. Conclusions

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 unexplained variance. The concept of having these different approaches tries to solve a fundamental question – why buildings with similar cost, taking into account the income they can generate, end up with different market values. The misalignment of estimated market value between different approaches indicates the existing unexplained variance. In the context of real estate market, architecture and real estate economics should be considered as a complex system that cannot be analyzed in parts. This research looks at the overlap between architecture and real estate economics. In today's context of behavioral economics and neuromarketing there is a need to recognize similarities of real estate to other asset class prices and design properties to be included within economic models.

There is a significant number of architectural factors that, according to literature review, might have an impact on real estate market value and can be used for valuation models. However, 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 its effect on 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 factors that have no additional cost, therefore creates value.

Although architectural factors are often interpreted only as ones contributing to a visual/ 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 non-design/ functional/ utilitarian to design/ abstract/ unexplained; and factors spanning from architectural design/ private to urban design/ public. 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.

A very multidimensional and complex system of architectural variables influencing a housing market value exists. It involves public outcomes, microeconomic factors, supply and demand models, and spatial dependency, which are integral parts of it. Circular transfers of value and reverse causality add another layer of complexity to the housing market. Understanding this system is crucial for housing development to succeed.

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