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Flat location and size as a determinant of homeownership duration

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Abstract

Motivation: Both the research on the residential market focuses primarily on analyses of the size and quality of the housing stock, or seeking dependencies with socio-economic factors. The second research area is the analysis of prices and construction of residential price indices. As an equally important issue is assessing the intensity of trade in particular types of flat and location. A standard view is that those small flats are more frequently traded on the market than large ones.
Aim: The study concerns analysis of ownership duration of a flat by the same owner (from the day of purchase to the sale day). It depends on the characteristics of the dwelling, including the location and size. The research will verify the hypothesis of a shorter duration for small units and its location. The study relies on the example of one local housing market. The study use regression analysis to examine the property value on the city's districts and duration analysis to explore ownership duration time, and nonparametric models of a proportional model Cox gambling with explanatory variables dependent on time.
Results: This research is significant in socio-spatial connection to the housing market. It shows that the current practice of buying a small flat as an investment in the housing market is appropriate. Due to the rapid price increase of small flats and high turnover, the chances for a good investment are increasing. With the help of the Cox model, the study shows that on the local market poor location in the old city housing estate and a larger floor area decreased the odds of a property to be sold quickly. The study results are valuable due to the unique role of housing on investing in the local market.

Keywords: property value; court procedure duration; housing characteristics
JEL: R38; R41

1. Introduction

Residential property sales are the most common real estate transactions in any country. This process is due to the need for housing but also to demographic and economic factors. The housing market operates in an economic, social, legal, and political environment (Ambrose, 1992, pp. 163–176; Golland, 1998, pp. 103–106). The relationship and coupling of the elements of this market system change over time; they have a different dimension in analysing individual local markets. Different relationships and dependencies are decisive in the analysis of selected housing sector segments.

The interconnectedness of buyers' actions in the housing market is linked to the market environment in which time, space, events and chance determine the choices made by individuals. Entities create facts in the real estate market due to circumstances occurring in a given place and time. These circumstances encourage entities to behave in a certain way; for example, advertising activities will prompt an individual to purchase a flat in a particular housing estate. Finally, the event is decided by chance — an unscheduled meeting with the person who obtained the offer to sell the flat or presence in a given place and time.

Operators work under conditions of insufficient information and its asymmetry. Buyers are not careful enough when examining the legal or technical condition of a flat, and often the only factor determining the purchase is financial resources. In such circumstances, two questions arise. Firstly, whether the selected locations (housing estates) are more popular than others, i.e. the transactions occur less often because the dwellers do not want to sell their flats. Secondly, it is important how long the homeowners stay with the property, and after how many years, on average, they sell their flat. It is also interesting whether the decision to sell sooner depends on the location (estate) or the size of the flat.

The purpose of this study is to examine the relationship between the duration of homeownership and the floor area and location of the property. The number of days from the last to the next sale of the flat is defined as the property ownership survival. Of course, the market situation influences homeowners' reluctance to sell in the long term. The research will verify the hypothesis of a shorter homeownership for small units and its location.

Each part of article refers to theoretical and application aspects of the examined problem. The analysis connected with is the duration of ownership. One local housing market in Poland presents the results of the research. It is also known that buyers' preferences and sellers' motivation determine the price of a flat. But in this research only measurable factors like area, number of rooms or floor were included. When analysing the problem, both theoretical and application aspects were addressed.

The first part of the paper reviews the literature, focusing on the factors that influence the decisions of home buyers and sellers. It is noted that both the location and area of the flat are pointed to be the most important determinants of decisions by market participants. The literature review shows that the duration of ownership of the same dwelling has not been analysed. This justifies the choice of the research method described in the next section. In the empirical part of the research the regression analysis is used to examine the value of properties in individual city districts, the survival analysis to explore homeownership duration and nonparametric models of a Cox proportional hazard model with explanatory variables dependent on time. The article ends with a discussion and conclusions of the research.

The study uses unique source data describing the structure of transactions and the time between them. It also presents the results of research on the housing real estate market in areas affected by the same pricing factors over a long time period. The research problems addressed are common in Poland, and the research results indicate that they occur at each local market.

The scale and scope of the study dictated the choice of a specific local market to be looked at. Data were needed on repeat sales, concluded over a long period.

2. Literature review

In numerous studies, the analysis of residential property sales deals with housing characteristics and their influence on the transaction price and the construction of regression models (Isakson, 1998, pp. 177–190; Rencher, 2002). Most commonly, hedonic price models are built to account for quantitative characteristics and the effect of time on price (Wu et al., 2018). There are also models that take location into account, known as spatial models and non-linear models (Miles, 2020, pp. 299–315).

There is a debate in the literature on the influence of qualitative variables and subjective opinions of buyers on the price of housing (Day, 2001). It concerns the measurement scale of these variables as well as the acquisition of reliable data and its sources (Jayantha & Oladinrin, 2020, pp. 357–371). Research often reveals surprising facts about the expectations and preferences of residents in multi-family buildings. Tajima (2020, pp. 281–297) shows that a community meeting room or outdoor space to host various events increases the price of housing by about 7 and 16 per cent respectively. In other models — of repeat sales — there is a problem of reliable data on the characteristics of the same flats after a long period of time. These are often series of even several decades, which means that during this time not only the assessments of the technical condition of the flat itself, but also the preferences of buyers may have changed significantly.

However, the literature lacks studies on the time after which owners sell their flats and on the factors influencing these decisions. Of course, there may be many reasons for decisions to sell. They may result from the real estate environment, the owners' individual family situations or other economic reasons observed in the market (Alkay, 2011, pp. 521–539). Consumers are more willing to buy flats with all amenities, but not in mixed-use buildings. People prefer to live in urban areas but at the same time do not want their dwelling to be located in high-density housing developments (Lee, 2016, pp. 483–501). Decisions to sell or buy a residential property are influenced by demographic factors, the stage of family development, and the economic status associated with exiting the labour market and entering retirement age. This is often the point at which elderly people decide to adapt their place of residence to their physical and budgetary constraints (Ewen & Carswell, 2019, pp.157–167). Government housing support programmes (Cai & Wu, 2019, pp. 934–951; Manase & Siamuzwe, 2020, pp. 125–141) are important for buyers' decisions and their strategies to acquire housing. Obtaining better housing with government support is conditional on not owning another home. This may induce some to sell their substandard housing in order to obtain better government-funded property.

Inference about mechanisms in the housing market is hampered by the low informational efficiency of this market (Case & Shiller, 1989, pp. 135–136; Herath & Maier, 2015). Buyers make decisions under conditions of information asymmetry and are guided in their choices by often irrational, emotional reasons. Across cultures, they are driven by both positive and negative opinions about location, neighbourhood, sometimes also by superstition, or other externalities in the housing market (Alkali et al., 2019, pp. 267–280).

The article shows the issue of the time that elapses between successive sales of the same flat. The reason for the short- or long-term retention of ownership is analysed. It can be assumed that small flats will sell more often than the large ones. They are in many cases treated as an investment and intended for rental. Large flats tend to meet the housing needs of owners and their families. They are rarely rented out. On the other hand, it is interesting to see whether there are locations where flats are more likely to be sold.

3. Research methodology

3.1. Empirical date

The research is based on the author's database of transactions (acquired from notarial deeds) on the cooperative housing market in Stargard, Poland. The data are divided into six cooperative housing estates: Chopin (CH), Kluczewo (K), Letnie (L), Stare Miasto (M), Pyrzyckie (P), and Zachód (Z). The analysis covers the cooperative housing market in Stargard that is homogeneous in terms of two types of ownership rights. The study uses the author's base of individual transactional data for the years 2000–2021 collected from notarial deeds and described by the price information and features of the premises (e.g., date of sale, price, area, location, etc.). The choice of the study area was not random. Firstly, due to its location, there are similar building structures, the same company (cooperative) manages the properties, the housing stock is spatially concentrated. The critical factor for the study was the availability of data on repeat transactions.

The dataset consists of 2266 transactions of sold flats (ownership or cooperative right) between May 4, 2000 and May 2, 2021. Several variables described the individual sales: total flat price in PLN (*Total Price*), price per unit in PLN/m^2 (*Unit Price*), transaction data (yyyy–mm–dd), usable floor area in m^2 (*Size*), number of rooms (*Room*), the floor the flat was located at (*Floor*), type of building (1 — low-rise building, 0 — high-rise building; *Building*), age of the building in years between the date of construction and current year (*Age*), the type of the ownership title (0 — cooperative right, 1 — property law; *Right*), the duration of ownership as the period between the second and first sale of the flat, in days (*Delta*). In this study, *LnPrice* is used as a logarithm of the unit price in many models.

3.2. Econometric methods

In order to estimate the impact of selected variables, the property value is regressed on several independent variables using a stepwise multiple linear regression model (Mayers, 1990). Additionally, the expected duration of homeownership is examined (duration analysis) and the effect of several salient variables on survival time are investigated.

Methodology stems from the work of Cox and Oakes (1984). The period between the start of the observation (first sale) and the event that ends the observation (resale), but first of all its likelihood in subsequent units of time are the subject of this study. Although a 20-year period was examined, there were flats that were sold during that time. If the event did not happen by the end of the observation, the observation was terminated (a censored observation). It was most often censored because of the time of termination (Blossfeld et al., 1989). If there had been no censored observations, regression analysis or non-parametric tests could be used for the study. In the study, the truncation is censored on the right side, which is often found in other analyses as well. The time of an event incidence t is a random variable of non-negative values. The variable is described by employing a distribute F(t), a density function $f(t)$, a survival function $S(t)$, a hazard function $h(t)$ of randomly chosen non-negative values and a cumulative hazard function o $H(t)$ as well as a plausibility function (L). The measure of the probability that in time $\langle 0;t \rangle$ the flat sale time is a distribution of a random variable t (continuous and non-negative) defined by the following formula:

$$F(t) = P(T \leq t) = \int_0^t f(z)dz, \quad (1)$$

where $F(t) \in \langle 0;1 \rangle$. A probability density function:

$$f(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t)}{\Delta t}, \Delta t > 0, \tag{2}$$

permits estimating the empirical distribution of events in the assumed duration intervals. The function of the probability that by the time *t* the episode ending event does not happen and the process is being continued is described as the following survival function:

$$S(t) = P(T > t) = exp\left(-\int_0^t h(z)dz\right). \tag{3}$$

The transition intensity rate is a hazard function described as:

$$h(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t | T \geq t)}{\Delta t}, \Delta t > 0. \tag{4}$$

That provides information about failure levels. It is the momentary potential for an event (sale) to occur, provided that the flat has not been sold by time t (Kleinbaum, 1996). The hazard function represents the probability per unit time, so it can also take values greater than 1.

The following formula describes the cumulative hazard function:

$$H(t) = \int_0^t h(z)dz, \tag{5}$$

while the plausibility function used for single episodes is described by:

$$L = \prod_k h(t_k)^{\delta_k} S(t_k), \tag{6}$$

where δ_k a censoring indicator would be of value 1 if the event occurred in the time t or value 0 when information was censored.

For correct estimation of the survival and hazard functions, a large sample is required to avoid bias in the estimators. Popular procedures of estimating theoretical survival function are grounded on the least-squares method and the weighted least squares method. They are also based on fitting one of the typical distributions of the exponential survival, hazard, Weibull or Gompertz functions to the empirical distribution (Bowers et. al., 1987). One of the commonly used methods of estimating the survival (duration) function that does not require arbitrarily defined time variable intervals is the Kaplan–Meier method (Hosmer & Lemeshow, 1999, pp. 28–31). This method estimates the survival function directly from continuous survival times, and the probability estimate sought is the product of successive conditional probabilities estimated separately. As a result of applying this procedure, truncated observations can also be taken into account.

Duration can be analysed with many additional factors in view and through nonparametric regression. In the model for every group distinguished due to its feature that is independent of duration, the survival function is estimated, and pairs of the obtained functions are compared through nonparametric tests (survival times do not have normal distribution).

In duration analysis it may be necessary to divide the set of observations into subgroups. Then for each subgroup the survival function is estimated and subsequently the durations are compared. The significance of differences is assessed by verifying the null hypothesis of no overall differences among survival functions, with the use of non-parametric tests e.g. Mantel–Haenszel with a chi-square distribution statistic.

The impact of many features on the expected duration of an unknown survival function can be measured through semi-parametric models, including the Cox proportional hazards model:

$$h(t : x_1, x_2, \ldots, x_n) = h_0(t) e^{\sum_{i=1}^{n} a_i x_i}, \tag{7}$$

where $h(t{:}x_1,x_2,\ldots,x_n)$ the first element of the model, parametrically non-specified time function t, a resultative hazard of given n— concomitant variables $x_1,x_2,\ldots,x_n$ and an adequate survival time and $h_0(t)$ the hazard function, for which all the variables equal zero (base hazard). The second element of the model $e^{\sum_{i=1}^{n} a_i x_i}$ — is a specified exponential function and a_i— model coefficients, t— observation time. The elementary method of estimating the model coefficients is the partial likelihood method, while in a popular Statistica software, the Cox model coefficients are estimated through the maximum likelihood method. The advantage of the model is that it does not require assumptions about the shape of the latent survival distribution, and the baseline hazard is a time-dependent function.

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4. Results

4.1. Variable analysis

In the article, Author considers the relationship between the price of flats and their characteristics, in particular the location of housing estates and the usable floor area of flats. In the next step, Author looks for determinants of home-ownership duration using the grouping variables: housing estates and groups of flat usable area.

Based on the sample, the author finds that the average flat size was 49.8 m^2; the most often sold flat was a two-room flat on the 3rd floor located in a building that was nearly 40 years old (Table 1).

The mean value of the flat was 2 743 PLN/m^2. However, the average prices and range of housing prices varied from one housing estate to another. Over the last twenty years, the average price was the highest in Chopin housing estate (CH) and the lowest in the estate of Kluczewo (K) (Chart 1). On the other hand, the lowest price about PLN 1,000/m^2) was in the Pyrzyckie housing estate (P), and the highest at about PLN 8,000/m^2 was seen in the Zachód (Z) estate. That difference indicates a multiple increase in prices between 2000 and 2021 and a firm price dependency on time.

In contrast, the opposite exponential effects were used to illustrate price dynamics. Chart 2 shows that between 2000 and 2021 there were three clear trends in house price dynamics in the housing estates under study: the first upward trend in 2000–2008, the decline in 2009–2013 and the price increase in 2014–2021. This result shows that time is an essential factor that should be consider the value of flats. The relative effect of the time of sale on the price is strong between 2006 and 2008 and weaker but increasing between 2016 and 2020.

In addition to time, other factors can affect the value of an flat. The author used multiple regression analysis to explore potential factors for residential property price. The flat value was regressed on several independent variables using a stepwise procedure. The estimation results are shown in the Table 2.

The model estimated on a sample of 2266 transactions has a moderate fit to the empirical data (R^2=0.68). Three variables were found that significantly affected the flat value. As noted earlier, the value of the flat depends significantly on the time of sale. Flats sold later are more expensive than those sold earlier. Larger floor area of the flat leads to an increase in LNPrice by 1.9%. Evidence was not found that location on floor or a number of rooms significantly impacts the flat value. It has also been shown that the flat ownership is valued higher on the market than cooperative rights. A negative LNPrice dependency occurs for a location on higher floors (but a parameter is not statistically significant). Chart 3 shows the distribution of the flat usable floor area. For further analysis, the set of transactions was divided according to the usable floor area of the flat. Symmetrical distribution of transactions in six groups corresponding to the flat size was obtained: group I (<30 m^2), group II (<40 m^2), group III (<50 m^2), group IV (<60 m^2), group V (<70 m^2) and group VI (70 m^2 and more). The next section investigates the duration of ownership.

In summary, average prices and the spread of housing prices were growing, but more importantly they varied from one housing estate to another. One may also notice two clear trends of increasing unit prices in the period under study, i.e. until 2009 and after 2014. Moreover, the structure of the floor area of flats sold in the examined period suggests a division of flats into six size groups.

4.2. Time of ownership and location duration analysis

In case of transactions being analysed in this paper, the duration analysis involves estimating a survival function, density function and hazard function. Duration time is a period between the date of the first and the repeat flat sale. Sales that did not repeat by 02 February 2021 were censored (right hand). In this case the duration could not be directly observed after the period of study.

The duration analysis focuses on the duration of flat ownership in two perspectives. First, a housing estate is used as a grouping variable. It was checked whether there are housing estates where flats were sold more often. Secondly, the duration of ownership of a flat was analysed in six groups of flat sizes. Basic statistics for the variable *Delta* for a repeat flat sale (but only complete observations, i.e. non-censored) were calculated in both cases (Table 3 and Table 4).

The shortest repeat sale time was seen in group I of flats with floor area smaller than 30 m^2, while the longest time of flat ownership by the same owner was seen in group V (with an floor area of 60–70 m^2). This group showed the lowest propensity to sell flats. This may mean that the above are optimum flat parameters for many owners. As regards location, the shortest time between repeat sales was in the Chopin housing estate (CH), while the longest — in the Pyrzyckie estate (P). The Pyrzyckie is very well perceived by residents as it is located in the vicinity of the city's ring road and single-family housing.

The estimation was based on four different distributions: exponential, Weibull, linear and Gompertz with different weights and maximum likelihood test (significant chi-square); they do not allow for a conclusion that the adjusted distribution is not significantly different from the empirical distribution. The estimators from the survival tables depend on the selection of the number and length of lifetime intervals. The estimators independent of data grouping are obtained using continuous survival times Kaplan–Meier method. Survival functions indicate the probability that time to repeat sale will be longer than the given time t. It can be deduced that with a probability equal to 82%, the time between sales will be longer than 21.4 years, with a probability equal to 96%, that the duration time will be longer than 2.4 years, and with a probability equal to 98% that the duration time will be longer than 1.4 years (Chart 4). Contrary to the survival function, the hazard function shows the probability of a flat to be sold within a given time t.

The data were grouped in two separate steps. First, the grouping variable was location (Estate) and second, the floor area variable (*Size* — in six groups). Six separate survival functions were estimated for each group and flat ownership durations were compared (separately for the variable grouping the housing estates and the flat floor area).

The null hypothesis H0 is S1(t)=S2(t)=S3(t)=S4(t)=S5(t)=S6(t) for all t stated that is no difference between the six survival functions. Statistics of chi-square independence value for the first survival function (Chart 5) indicate that there are some differences between the duration functions (chi-square goodness-of-fit test, where $\chi 2=19.48$, df=5, p=0.00157).

It can be seen that the probability of the same owner maintaining ownership of the flat is highest in the Zachód estate and lowest in the Kluczewo estate. The Kluczewo estate is characterised by small flats, an unfavourable location in the city limits, and the quality of the buildings themselves. These are buildings adapted to residential functions after the former Soviet army barracks. The shape of the survival function also indicates a slower/quicker decline compared to other housing estates. After 11 years, the Zachód housing estate is characterised by a slower decline of the survival function, which means that the probability of not selling a flat after that time increases, compared to the other housing estates.

Similarly, in case of the second grouping variable, the statistics of chi-square independence value (Chart 6) indicate that there are some differences between the determined duration functions ($\chi 2=26.68$, df=5, p=0.00007).

In the case of the survival function with the variable grouping flats by their size (*Size*), the outlier group 1 — the smallest flats — draws attention. For further easier assessment of significant differences between the duration functions, histograms of the sum of points can be employed (Chart 7).

In terms of location, Stare Miasto (M) and Zachód (Z) estates clearly differ from the others. On the other hand, in the case of the variable grouping the flats by their floor size, the smallest flats, which are most often traded on the market, clearly stand out.

To explore duration time in more detail, nonparametric methods like the Cox proportional hazard models can be applied. The method can be used to measure the effect of several variables (measured on different scales) on survival time. The Cox proportional hazard model allows us to examine the risk that a particular outcome (in our case the sale) occurs in time t for a given set of predictors. Several plausible factors that could potentially affect the duration of ownership were used. Two models were estimated with two grouping variables (*Estate*, *Size*). The results are shown in the Table 5. The $p>0.05$ values indicating statistically insignificant parameter estimates for the floor area and the building age variables may be due to their strong correlation. Buildings constructed in a given technology in individual housing estates had standardised housing units, with strictly specified floor area.

In both models, the ownership duration time depended upon the unit price and property right. A stronger property right (ownership) increases the probability of selling a flat. This is the case for housing estates as well as for the analysed groups of flat sizes. Other independent variables were not statistically significant, thus had limited explanatory value. Estimation results must be treated with caution. Low model fit may suggest that multivariate survival analysis using the Cox proportional-hazard model has limited value in explaining the effect of several factors upon the duration time, especially in the currently available independent variables.

5. Discussion

The validity of the results obtained within the study reflects the quality of data available, especially regarding the limited information on characteristics of flats being the subject of sale. The duration of a flat ownership by the same owner is affected by both: (1) location in a particular housing estate, (2) usable floor area of the flat.

The results confirm the determined duration functions that differ in their course and dynamics due to the indicated grouping variables. The location on the floor or the height of the building turned out to be insignificant. The influence of the usable floor area of flats on decisions to sell justifies the conviction that small flats are likely to be more often on the market due to their investment character, but also because they do not sufficiently satisfy the growing housing needs. This may be related to family enlargement or improved owner's material status.

The obtained results are unique, as there are no analyses of this problem in the literature. The problem is important insofar as it also answers the question of the inhabitants' propensity to change their housing conditions. The results indicate rather low residential mobility and low propensity to change housing conditions.

6. Conclusion

The article focuses on the analysis of the time elapsed between successive sales of the same flat. The unique nature of the collected data on repeated sales of flats and the time series of more than 20 years permit the formulation of some interesting conclusions and confirm earlier intuitive assumptions.

It has been shown that the length of time a flat remains with the same owner depends on the flat price and the ownership right to the premises. It has also been shown that the probability of being sold after a certain time differs considerably between the studied housing estates and with the size of the flat. The results obtained from the estimation of regression models are not entirely satisfactory, which indicates the need for research with additional variables. The noticeable overlapping of survival curves (Chart 5, Chart 6) in all groups suggests testing for differences between pairs in subsequent articles.

Future research should be extended to include qualitative factors influencing sales decisions of residents of the studied housing estates. It is also worth extending the direction of research to demographic factors such as age or structure of families deciding to sell a flat. It should also be supplemented with an analysis of other locations in the city, apart from cooperative housing estates. This would allow excluding the management method (management company) as a factor determining the decision of residential property sellers.

References

Alkali, M., Sipan, I., & Razali, M.N. (2019). The effect of negative information on the volatility of real estate residential prices in Abuja, Nigeria. *International Journal of Housing Markets and Analysis*, 13(2), 267–280. https://doi.org/10.1108/IJHMA-03-2019-0036.

Alkay, E. (2011). The residential mobility pattern in the Istanbul metropolitan area. *Housing Studies*, 26(4), 521–539. https://doi.org/10.1080/02673037.2011.559752.

Ambrose, P. (1992). The performance of national housing systems: a three nations comparison. *Housing Studies*, 7(3), 163–176. https://doi.org/10.1080/02673039208720733.

Blossfeld, H.-P., Hamerle, A., & Mayer, K.U. (1989). *Event history analysis: statistical theory and application in the social sciences*. Psychology Press. https://doi.org/10.4324/9781315808161.

Bowers, N.L., Gerber, H.U., Hivkman, J.C., Jones, D.A., & Nesbitt, C.J. (1987). Actuarial mathematics. *Transactions of the Faculty of Actuaries*, 41, 91–94.

Cai, X., & Wu, W.-N. (2019). Affordable housing policy development: public official perspectives. *International Journal of Housing Markets and Analysis*, 12(5), 934–951. https://doi.org/10.1108/ijhma-08-2018-0063.

Case, K.E., & Shiller, R.J. (1989). Association the efficiency of the market for single-family homes. *The American Economic Review*, 79(1), 125–137.

Cox, D.R., & Oakes, D. (1984). *Analysis of survival data*. Chapman & Hall.

Day, B. (2001). *The theory of hedonic markets: obtaining welfare measures for changes in environmental quality using hedonic market data*. Retrieved 02.09.2021 from https://discovery.ucl.ac.uk/id/eprint/17583/1/17583.pdf.

Ewen, H.H., & Carswell, A. (2019). Differences in conventional and seniors-oriented flat management. *Facilities*, 37(3/4), 157–167. https://doi.org/10.1108/f-12-2017-0121.

Golland, A. (1998). *Systems of housing supply and housing production in Europe: a comparison of the United Kingdom, the Netherlands and Germany*. Routledge. https://doi.org/10.4324/9780429437854.

Herath, S., & Maier, G. (2015). Informational efficiency of the real estate market: a meta-analysis. *Journal of Economic Research*, 20(2), 117–168. http://dx.doi.org/10.17256/jer.2015.20.2.001.

Hosmer, D.W., & Lemeshow, S. (1999). *Applied survival analysis: regression modeling of time to event data*. Wiley.

Isakson, H.R. (1998). The review of real estate appraisals using multiple regression analysis. *Journal of Real Estate Research*, 15(2), 177–190. https://doi.org/10.1080/10835547.1998.12090922.

Jayantha, W.M., & Oladinrin, O.T. (2020). Bibliometric analysis of hedonic price model using Citespace. *International Journal of Housing Markets and Analysis*, 13(2), 357–371. https://doi.org/10.1108/ijhma-04-2019-0044.

Kleinbaum, D.G. (1996). Survival analysis: a self- learning text. Springer.

Lee, J.S. (2016). Measuring the value of flat density: the effect of residential density on housing prices in Seoul. *International Journal of Housing Markets and Analysis*, 9(4), 483–501. https://doi.org/10.1108/ijhma-08-2015-0047.

Manase, D., & Siamuzwe, V. (2020). The effectiveness of the housing needs and demand. *International Journal of Housing Markets and Analysis*, 13(2), 125–141. https://doi.org/10.1108/ijhma-12-2018-0103.

Mayers, R.H. (1990). *Classical and modern regression with application*. Duxbury.

Miles, W. (2020). Home prices and fundamentals: solving the mystery for the g–7 by accounting for nonlinearities. *International Journal of Housing Markets and Analysis*, 13(2), 299–315. https://doi.org/10.1108/ijhma-03-2019-0029.

Rencher, A.C. (2002). *Methods of multivariate analysis*. Wiley.

Tajima, K. (2020). Shared amenities' impacts on condominium resale values. *International Journal of Housing Markets and Analysis*, 13(2), 281–297. https://doi.org/10.1108/ijhma-03-2019-0038.

Wu, H., Jiao, H., Yu, Y., Li, Z., Peng, Z., Liu, L., & Zeng, Z. (2018). Influence factors and regression model of urban housing prices based on internet open access data. *Sustainability*, 10(5), 1–17. https://doi.org/10.3390/su10051676.

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Appendix

Table 1.
Descriptive statistics for the complete sample

Variable	Mean	Median	Sample size	Min	Max	SE	Skewness	Kurtosis
Size (m^2)	49.8	48.4	137.0	16.0	114	13.31	0.34	0.15
Unit price (PLN/m^2)	2 743	3 036	10	262	8 635	1 119	0.02	−0.71
Room	2	2	975	1	5	0.91	0.31	−0.45
Floor	3	2	447	1	11	2.20	1.30	2.25
Building	1	1	1 788	0	1	0.41	–1.42	0.01
Age	39.5	42.0	201.0	19.0	60.0	9.6	−0.09	−0.87
Right	0	0	1 223	0	1	0.50	0.16	−1.98
Delta	2 070	1 966	2	4	6 667	1 430	0.68	0.08

Source: Own preparation.

Table 2.
Estimation results (dependent variable is LN Price)

Variables	B	SE	t(2258)	p
Constant	10.075	0.058	173.548	0.000
T	0.062	0.002	31.284	0.000
Size (m^2)	0.019	0.001	15.635	0.000
Room	0.004	0.017	0.217	0.828
Floor	−0.001	0.003	−0.218	0.827
Building	0.020	0.019	1.101	0.271
Age	0.001	0.001	1.306	0.192
Right	0.081	0.021	3.842	0.000
R^2=0.68				

Source: Own preparation.

Table 3.
Group descriptive statistics variable *Delta* for repeat flat sale (no. of days)

Group	Mean	Median	Min	Max	Quartile 1	Quartile 3	SE	Skewness	Kurtosis
Total	2 070	1 966	4	6 667	966	2 881	1 430	0.68	0.08
I	1 799	1 547	77	6 069	349	2 773	1 543	0.79	0.01
II	1 880	1 680	4	6 667	707	2 666	1 534	1.07	1.25
III	2 065	2 017	6	5 030	1 149	3 105	1 348	0.26	−0.80
IV	1 864	1 805	116	4 346	1 041	2 592	1 084	0.36	−0.53
V	2 852	2 163	775	6 373	1 457	4 501	1 723	0.74	−0.74
VI	2 205	1 996	366	5 354	1 115	2 922	1 323	0.76	0.15

Source: Own preparation.

Table 4.
Housing estate descriptive statistics variable *Delta* for repeat flat sale (no. of days)

Estate	Mean	Median	Min	Max	Quartile 1	Quartile 3	SE	Skewness	Kurtosis
Total	2 070	1 966	4	6 667	966	2 881	1 430	0.68	0.08
CH	1 525	1 332	78	4 337	512	2 448	1 149	0.74	−0.08
K	2 334	2 263	6	6 667	1 383	3 178	1 493	0.84	1.17
L	2 213	2 118	151	4 914	1 004	3 173	1 481	0.37	−0.77
M	1 953	1 680	4	6 069	712	2 746	1 464	0.59	−0.47
P	2 651	2 380	137	6 354	1 586	3 739	1 597	0.67	−0.11
Z	2 030	1 924	43	5 470	1 179	2 842	1 242	0.62	0.23

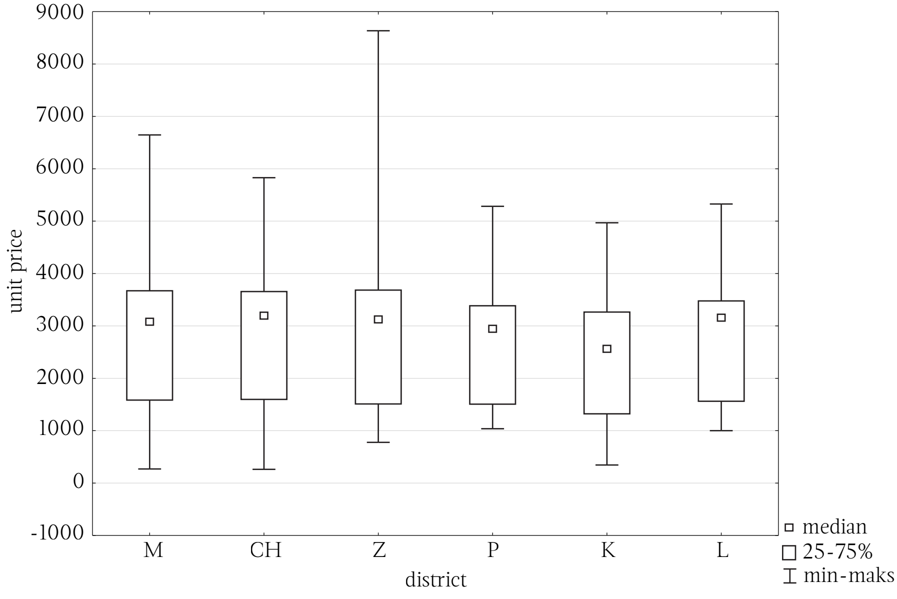
Source: Own preparation.

Table 5.
Evaluation of the parameters of the Cox proportional hazard function

Parameter	B	SE	t	Wald statistics	p-value	Hazard ratio
			Grouping variable: *Estate*			
Size (m^2)	−0.005	0.022	−0.243	0.059	0.808	0.995
Unit price	0.001	0.000	−5.953	35.437	0.000	1.000
Room	−0.204	0.159	−1.287	1.657	0.198	0.815
Floor	0.040	0.032	1.272	1.619	0.203	1.041
Building	0.141	0.201	0.700	0.490	0.484	1.151
Age	−0.005	0.011	−0.520	0.271	0.603	0.995
Right	0.644	0.186	3.457	11.953	0.001	1.903
			Grouping variable: *Area*			
Unit price	−0.001	0.000	−6.000	36.005	0.000	0.999
Room	−0.244	0.155	−1.574	2.478	0.115	0.784
Floor	0.046	0.031	1.481	2.192	0.139	1.047
Building	0.281	0.187	1.504	2.263	0.132	1.325
Age	−0.002	0.007	−0.328	0.108	0.743	0.998
Right	0.666	0.186	3.576	12.791	0.000	1.947

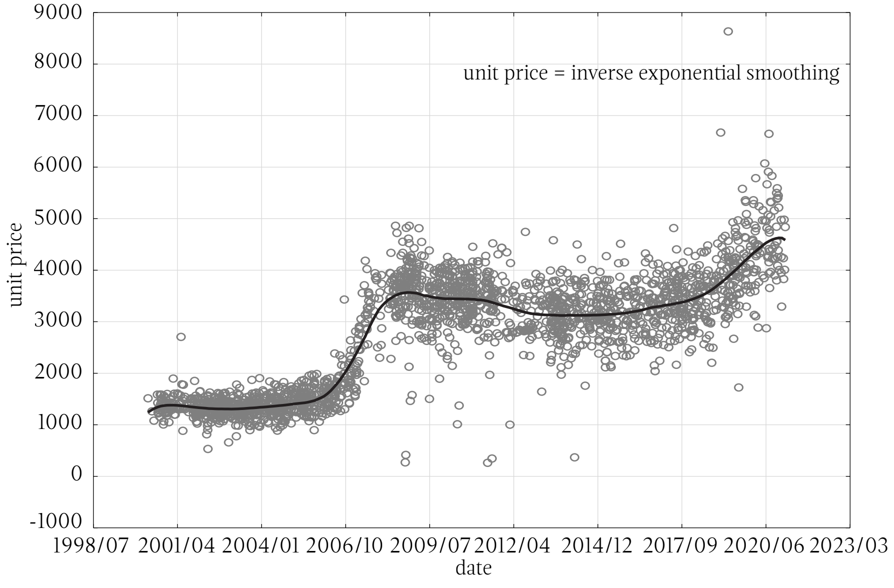
Source: Own preparation.

Chart 1.
The averages of unit prices in housing estates (PLN/m²)



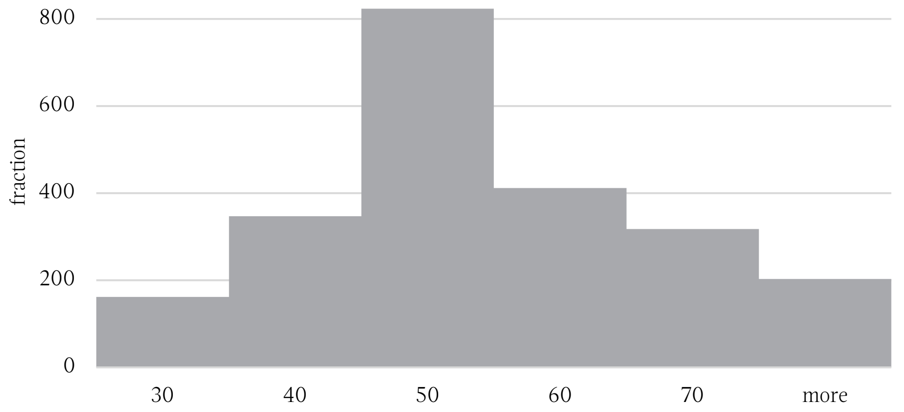
Source: Own preparation.

Chart 2.
Unit price dynamics of flats (PLN/m²)



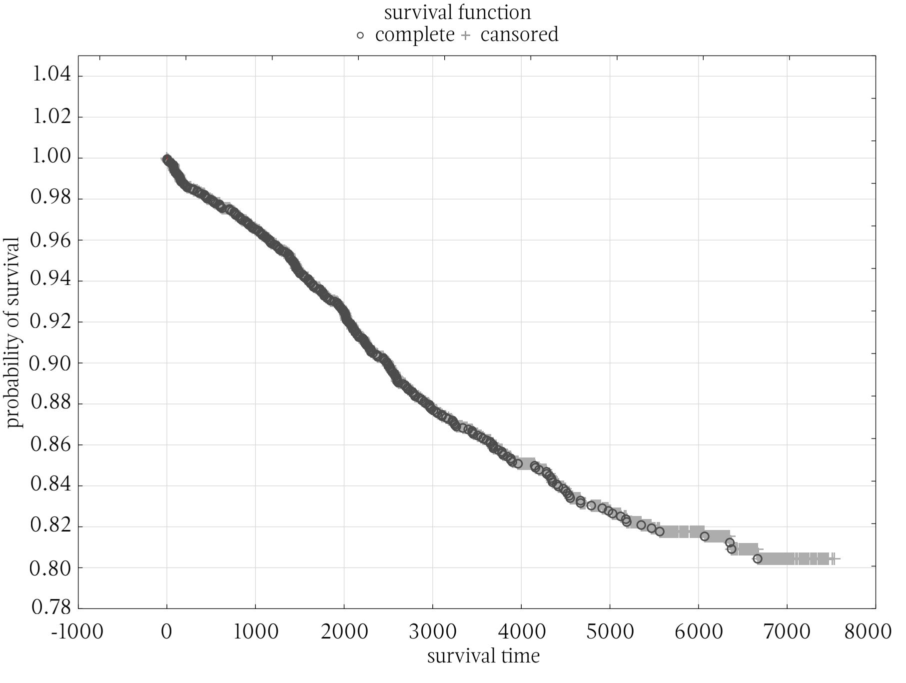
Source: Own preparation.

Chart 3.
The distribution of usable floor area (m²)



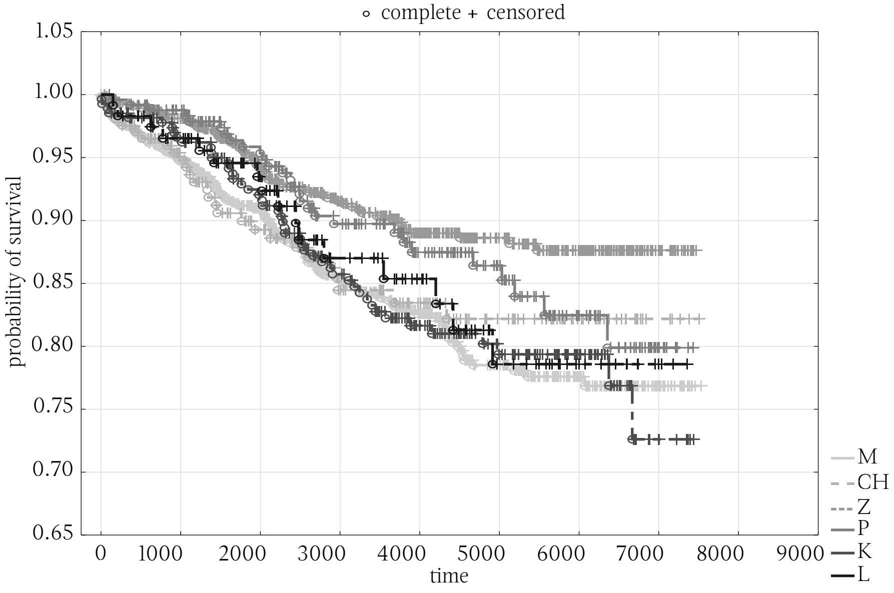
Source: Own preparation.

Chart 4.
Survival function plot



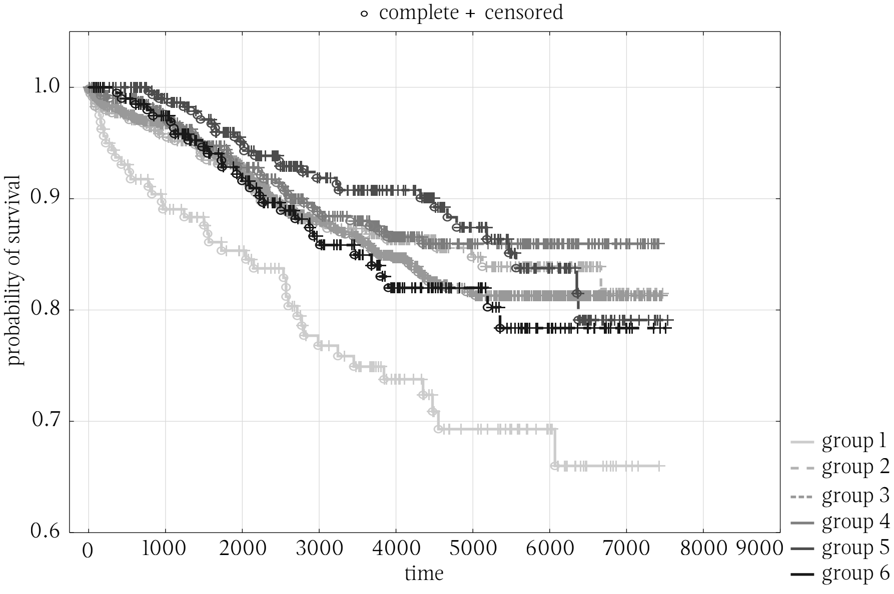
Source: Own preparation.

Chart 5.
Survival functions: Kaplan–Meier method (grouping variable *Estate*)



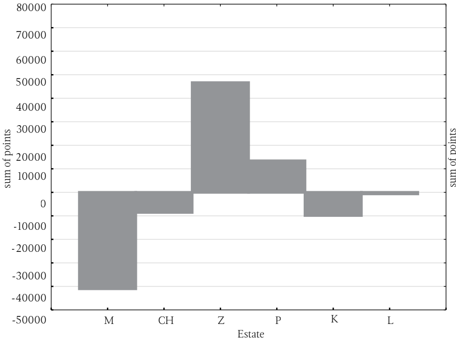
Source: Own preparation.

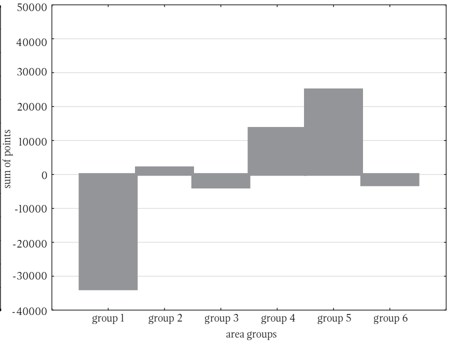
Chart 6.
Survival functions: Kaplan–Meier method (grouping variable *Size*)



Source: Own preparation.

Chart 7.
Histogram of the sum of points for each group of flats according to the grouping variables (left — *Estate*, right — *Size*)





Source: Own preparation.