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Self-reported and Market Home Values in Housing Wealth Inequality Measurement: Evidence from Warsaw and Prague

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Abstract: *This paper aims to examine whether self-reported home valuations can be a substitute for objective market data in studies on the level of housing wealth inequality. In order to achieve this aim, information on subjective values of flats and their features in Warsaw (Poland) and Prague (Czechia) was used. Next, hedonic models were estimated to calculate the objective values of these residential properties. The results indicated that, on average, homeowners overestimated their real estate by 2.10% in Warsaw and underestimated by 5.49% in Prague. Finally, using tests for the equality of variances, it was examined whether the level of housing wealth inequality differed significantly when calculated using subjective and objective home values. The findings showed that self-reported home values cannot serve as a perfect proxy for market values when assessing the level of housing wealth inequality in both cities.*

Keywords: coefficient of variation; hedonic model; housing wealth inequality; Prague; subjective versus objective, Warsaw.

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Introduction

Housing goods are highly heterogeneous in nature, leading to large differences in housing wealth in society. Measuring this wealth is extremely important to properly shape redistribution, housing, and taxation policies. In the scientific literature to date, the issue of assessing the level of housing wealth inequality has not been addressed very often. Some of the few studies have been done by Lux et al. (2013; 2021), Sunega and Lux (2018) and Wang et al. (2020), among others. In all these studies, the authors used property transaction prices or real estate values to calculate the magnitude of housing wealth inequality. In terms of property values, they applied interchangeably either subjective values, reported by property owners or objective values, estimated using a hedonic method (Rosen 1974). However, studies on the accuracy of self-reported home valuations indicate that, in general, owners tend to overestimate their properties (Kish and Lansing 1954; Robins and West 1977; Goodman and Ittner 1992; Agarwal 2007; Benítez-Silva et al. 2015; Haurin et al. 2018; Gao and Liang 2019; Tur-Sinai et al. 2020). This is mainly due to the so-called endowment effect, which leads to overvaluing things we own (Bao and Gong 2016). Additionally, several other factors reduce the accuracy of owners' valuations of their homes, including asymmetric information (Wit and Klaauw 2013), anchoring heuristic (Leung and Tsang 2013) and loss aversion tendency (Genesove and Mayer 2001). However, it is important to ask whether property-owner valuations are so inaccurate as to prevent reliable measurement of the level of housing wealth inequality. To date, no scholarly work has attempted to answer this question, and thus the main purpose of this paper is to assess whether subjective property values can be treated interchangeably with market values or transaction prices when assessing the degree of housing wealth inequality in the examples of Warsaw (Poland) and Prague (Czech Republic). Another contribution of this paper to the literature is the estimation of the degree of accuracy of self-reported home valuations, which has so far not been studied in any Central and Eastern European country. In addition, the paper provides new evidence on the level of housing wealth inequality in Poland, the assessment of which, compared to the Czech Republic, has not been frequently undertaken (Yemtsov 2007; Grejcz and Żółkiewski 2017; Brzezicka et al. 2020). It should also be emphasised that the findings presented in this article are useful for other large European cities, especially those located in Central and Eastern Europe.

Data and method

The study area includes the two largest residential markets in Poland and the Czech Republic, i.e., the cities of Warsaw and Prague. Data on subjective and objective values of the same residential properties are collected for both cities. In the case of the city of Warsaw, the former was obtained through an original questionnaire survey carried out between the 6th and 10th of November 2020 (Tomal 2021). Bao (2020) recommended that the survey be executed on an online panel data platform. Specifically, the largest such platform in Poland was selected (DRB Research), which consists of over one million panellists. Responses were obtained based on a random selection of interviewees. For Prague, on the other hand, data from the 4th wave of the Czech Household Panel Survey (www.promenyceskespolecnosti.cz) carried out in 2018 was used. In the end, 1,000 data records from Warsaw and only 60 from Prague were used, and their characteristics are presented in Table 1.

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In order to estimate the hedonic models needed to determine the objective values of respondents' properties, data from the state Register of Prices and Values of Real Estate on residential property transaction prices dating from September-November 2020 was used in the case of Warsaw. On the other hand, in the context of Prague, data from 2018 on market values of residential properties determined for banking purposes was gathered (this data is not publicly available).

Table 1: Descriptive statistics for survey data

Variable	Warsaw		Prague	
	Mean [PLN]	Standard deviation [PLN]	Mean [CZK]	Standard deviation [CZK]
Subjective value of a flat [S]	685,778.44	372,120.11	4,770,833.33	2,093,255.75
Dwelling physical features				
Number of rooms	2.25	1.40	2.83	0.85
Floor area	61.41	31.32	73.73	22.46
Dwelling locational features				
Distance in a straight line in meters to the city centre (old town)	4,598.68	2,448.82	6,638.49	2,342.61
Dwelling neighbourhood features				
Distance in a straight line in metres to the nearest park	738.93	736.01	164.62	119.16
Distance in a straight line in metres to the nearest school	699.78	996.11	350.51	342.25
Distance in a straight line in metres to the nearest bus or tram stop	285.66	307.73	229.83	152.47
Distance in a straight line in metres to the nearest supermarket	448.50	518.19	425.13	445.75

Source: own study.

The research process can be divided into three stages. In the first stage, hedonic models are estimated for Warsaw and Prague in the following form:

$$\ln p_j = \beta_0 + \sum_{k=1}^{K} \beta_k \ln x_{jk} + \varepsilon_j \quad (1)$$

where j concerns flats from the transaction price (market value) database, p_j is the transaction price (PLN) or the market value (CZK) of the j-th flat depending on the city studied, ε_j is the error term, $\ln x_{jk}$ is the k-th ln explanatory variable. The set of covariates includes the dwelling's characteristics presented in Table 1. After calibrating the above model, the objective market value of each flat i is estimated as:

$$V_i = \exp\left(\hat{\beta}_0 + \sum_{k=1}^{K} \hat{\beta}_k \, ln \, x_{ik}\right) \quad (2)$$

where i concerns dwellings from the survey questionnaire database. The second stage of the study estimates the level of housing wealth inequality for both objective and subjective data using one of the most common measures of inequality: the variance. Finally, it is checked whether the estimated variances differ significantly from each other. For this purpose, the Morgan-Pitman, McCulloch, Sandvik-Olsson and T tests for paired samples are used (Wilcox 1990). In each of the above tests, the null hypothesis takes the form:

$$H_0: \sigma_s^2 = \sigma_o^2 \quad (3)$$

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where s refers to data on subjective values while o to data on objective values. For the Morgan-Pitman test, testing hypothesis (3) requires an analysis of the correlation between $S - V$ and $S + V$. If the Pearson correlation coefficient is significantly different from zero, then hypothesis (3) is rejected. However, the approach presented in the Morgan-Pitman test is not robust to nonnormality. Therefore, in the McCulloch test, the Spearman correlation coefficient is examined. On the other hand, the T test for hypothesis (3) requires calculating a new variable $D_i = W_i - U_i$ where $W_i = (S_{2i-1} - S_{2i})^2/2$ and $U_i = (V_{2i-1} - V_{2i})^2/2$. Then the student's test is performed for D_i. Finally, the Sandvik-Olsson method testing hypothesis (3) uses the Wilcoxon signed-rank test for the variable $G_i = |S_i - M_S| - |V_i - M_V|$ where for even numbers $M_S = (S_{(n/2)} + S_{(n/2+1)})/2$ and M_V is defined in the same way.

Results and discussion

The empirical study started with the estimation of hedonic models, and the results of this analysis are presented in Table 2. As can be seen in both cases, the models, even despite the small number of variables, were able to explain to a large extent the variation in the data compared to other studies on the Warsaw (Trojanek et al. 2021) and Prague housing markets (Melichar and Kaprová 2013). Looking at the directions of the impact of individual covariates on prices, one can conclude that they are in line with predictions. In both cities, a larger area of the flat increases the price and a larger number of rooms, determining its decrease. Similar consistency can be observed in terms of proximity to the city centre, i.e., flats located on the outskirts are less valuable. Interestingly, divergent estimation results appeared in the case of variables concerning the proximity of a supermarket and a school. In the case of the Warsaw housing market, the presence of a supermarket and a school increases the price of a flat, while the opposite situation is visible in Prague, which may be due to the noise generated by such facilities. The remaining variables, i.e., describing the distance to a park or public transport stop, turned out to be statistically insignificant.

Next, on the basis of estimated hedonic models, the market values of respondents' flats were calculated, and then the corresponding valuation bias as $\frac{S_i - V_i}{V_i} * 100\%$. The results of this analysis are presented in Figure 1, which shows that in the Warsaw residential market, the subjective and objective values coincide to a very large extent, which is also evidenced by a small average valuation error of 2.10%. A similar magnitude of average valuation bias has been noted for the U.S. and Australian real estate markets (Melser 2013; Windsor et al. 2015; Haurin et al. 2018). In the case of the Prague property market, a certain degree of agreement between market values and those reported by owners can also be observed, but it is smaller than in Warsaw. In Prague, the average valuation bias was –5.49%, which is at the limit of the acceptable margin of error (Kucharska-Stasiak 2013). This higher estimation error in Prague may be because information asymmetry occurs to a greater extent in this city than in Warsaw. Several rationales for this hypothesis can be pointed out. Firstly, Prague has a smaller property market than Warsaw; e.g., the number of primary market transactions in Prague was around 5,000 compared to 7,500 in Warsaw in 2018. Secondly, the property market in Warsaw is much better researched, which is a direct result of the difficulty of accessing transaction price data in Prague, which, unlike in Warsaw, is made available for research purposes for a fee. It is also interesting that the average valuation bias in Warsaw is positive, while in Prague, it is negative. This can be explained by analysing the societies in both countries studied using the Hofstede

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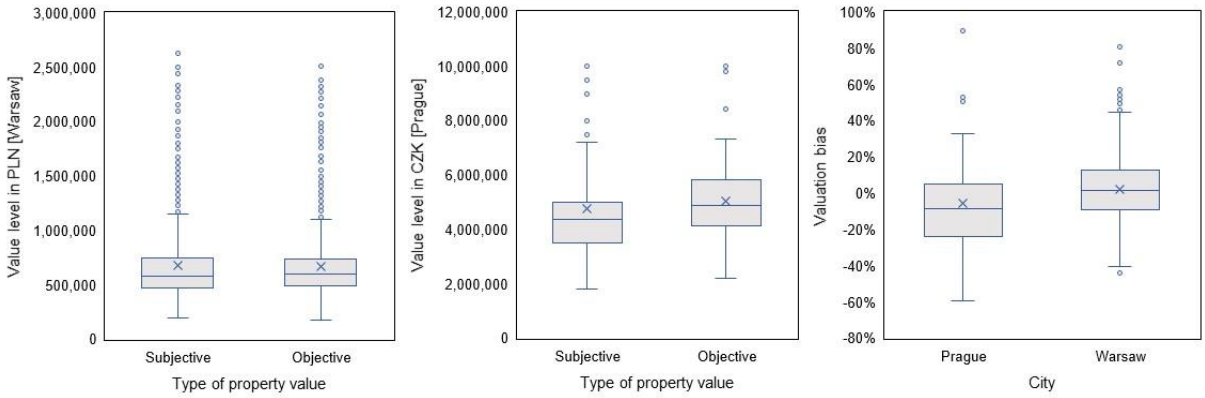
indices (https://www.hofstede-insights.com). When looking at the four basic dimensions of culture, for three of them, i.e., for power distance, individualism and masculinity, the societies in Poland and the Czech Republic do not differ much. The only exception is the cultural dimension of uncertainty avoidance, which has a value of 93 in Poland and 74 in the Czech Republic. As noted by Wang et al. (2017), people from cultures with higher levels of uncertainty avoidance are more sensitive to potential losses, which leads to an increased level of loss aversion tendency. This, in turn, is one of the two premises for the occurrence of the endowment effect (Kahneman et al. 1991), causing the overvaluation of goods.

Table 2: Hedonic models estimates

Variable	Warsaw	Prague
Intercept	10.4065***	13.2778***
Ln floor area	1.1182***	0.9750***
Ln rooms	–0.1608***	–0.1041***
Ln distance to city centre	–0.1262***	–0.2674***
Ln distance to supermarket	–0.0212***	0.0350***
Ln distance to school	–0.0513***	0.0338***
Ln distance to park	–0.0021	0.0045
Ln distance to bus/tram stop	0.0020	–0.0027
R^2	0.7055	0.8437
N	3,599	1,260

Note: *** one per cent level of significance.
Source: own study.

Figure 1: Valuation bias analysis estimates



Source: own study.

In the next stage of the study, coefficients of variation were estimated for objective and subjective flat values in both cities to measure the degree of housing wealth inequality. In Warsaw, the value of this coefficient was 0.52 for owner-reported data and 0.49 for values estimated by the hedonic model. It should be stressed that these numbers are much higher than those determined by Brzezicka et al. (2020), but the latter study analysed a narrow section of the Warsaw housing market covering only flats between 40 and 60 m^2. In the context of Prague, the coefficient of variation is 0.30 for objective and 0.44 for subjective data. Compared to Warsaw, these results indicate greater equality between the inhabitants of this city in terms of housing wealth. Finally, we tested whether self-reported home valuations can be a replacement for market values when analysing the level of housing wealth inequality using the Morgan-

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Pitman, McCulloch, T and Sandvik-Olsson tests. The obtained results revealed that self-reported valuations could not serve as a perfect proxy for market values of properties in housing wealth inequality assessment (see Table 3). In particular, all the tests performed for equality of variances indicate rejection of hypothesis (3).

Table 3: Estimates of tests for the equality of variances

Test	Test statistic value [Correlation]		P-value		Conclusion	
	Warsaw	Prague	Warsaw	Prague	Warsaw	Prague
Morgan-Pitman	[0.27]	[0.39]	<0.01	<0.01	$\sigma_s^2 \neq \sigma_o^2$	$\sigma_s^2 \neq \sigma_o^2$
McCulloch	[0.20]	[0.35]	<0.01	<0.01	$\sigma_s^2 \neq \sigma_o^2$	$\sigma_s^2 \neq \sigma_o^2$
T	–3.29	–3.79	<0.01	<0.01	$\sigma_s^2 \neq \sigma_o^2$	$\sigma_s^2 \neq \sigma_o^2$
Sandvik-Olsson	5.00	2.55	<0.01	<0.01	$\sigma_s^2 \neq \sigma_o^2$	$\sigma_s^2 \neq \sigma_o^2$

Source: own study. Note: A significance level of 0.05 was assumed.

Conclusion

This study aimed to examine whether self-reported home valuations can be used to measure the level of housing wealth inequality in the example of the cities of Warsaw and Prague. The analysis results indicated that property owners, on average, overestimate their real estate by 2% in Warsaw, while in Prague, they underestimate it by more than 5%. Finally, using tests for the equality of variances, it was concluded that the subjective values of properties in both cities could not be a perfect substitute for their market values when examining the degree of housing wealth inequality.

This research has several limitations. The first concerns the study area, which covered large urban housing markets and therefore, the research conclusions are useful for similar agglomerations. Secondly, the survey questionnaire on subjective property values in Prague was not designed specifically for the research presented in this article. Consequently, the database used is small compared to that from Warsaw and includes few variables describing property characteristics. Thirdly, to assess the degree of housing wealth inequality, the variance was used, which, like any such measure, has some drawbacks. In the case of the variance, one should mention the lack of upper and lower limits of value and excessive sensitivity to outliers. When considering the presented research limitations, future analysis should focus on studying smaller housing markets using alternative measures of housing wealth inequality. In particular, bounded measures should be used to examine whether self-reported valuations can at least be a good proxy for market values when determining the level of housing wealth inequality. Subsequent studies should also conduct the survey presented in this article in different population subgroups, as the valuation bias may depend on the characteristics of the respondents.

The research results also have implications, in particular, for housing studies. Namely, researchers can properly design their research procedures by knowing whether subjective data can be used to measure the degree of housing wealth inequality. This study is also important for policy, especially that concerning a redistribution. This applies mainly to the housing market in Prague. In this case, it can be assumed that correcting the subjective perception of Prague

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residents will contribute to a decrease in support for government housing redistribution since the objective level of housing wealth inequality is much smaller than that perceived by the public.

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References

Agarwal, S. 2007. 'The Impact of Homeowners' Housing Wealth Misestimation on Consumption and Saving Decisions.' *Real Estate Economics* 35 (2): 135-154. DOI: 10.1111/j.1540-6229.2007.00185.x.

Bao, H. 2020. 'Endowment effect and house price determination.' Pp. 78-94 in H. Bao *Behavioural Science and Housing Decision Making*. London: Routledge. DOI: 10.1201/9780429027253.

Bao, H. X., C. M. Gong 2016. 'Endowment Effect and Housing Decisions.' *International Journal of Strategic Property Management* 20 (4): 341-353. DOI: 10.3846/1648715X.2016.1192069.

Benítez-Silva, H., S. Eren, F. Heiland, S. Jiménez-Martín 2015. 'How Well Do Individuals Predict the Selling Prices of Their Homes?' *Journal of Housing Economics* 29: 12-25. DOI: 10.1016/j.jhe.2015.04.001.

Brzezicka, J., M. Gross, K. Kobylińska 2020. 'The Applicability of the Gini Coefficient for Analyses of Real Estate Prices.' *World of Real Estate Journal* 1 (111): 4-15. DOI: 10.14659/WOREJ.2020.111.01.

De Wit, E. R., B. van der Klaauw 2013. 'Asymmetric Information and List-Price Reductions in the Housing Market.' *Regional Science and Urban Economics* 43 (3): 507-520. DOI: 10.1016/j.regsciurbeco.2013.03.001.

Gao, N., P. Liang 2019. 'Home Value Misestimation and Household Behavior: Evidence from China.' *China Economic Review* 55: 168-180. DOI: 10.1016/j.chieco.2019.04.003.

Genesove, D., C. Mayer 2001. 'Loss Aversion and Seller Behavior: Evidence from the Housing Market.' *The Quarterly Journal of Economics* 116 (4): 1233-1260. DOI: 10.1162/003355301753265561.

Goodman, J. L., J. B. Ittner 1992. 'The Accuracy of Home Owners' Estimates of House Value.' *Journal of Housing Economics* 2 (4): 339-357. DOI: 10.1016/1051-1377(92)90008-E.

Grejcz, K., Z. Żółkiewski 2017. 'Household Wealth in Poland: The Results of a New Survey of Household Finance.' *Bank i Kredyt* 48 (3): 295-326. Retrieved April 20, 2022, from https://bankandcredit.nbp.pl/content/2017/03/BIK_03_2017_03Zolkiewski.pdf.

Haurin, D., S. Moulton, W. Shi 2018. 'The Accuracy of Senior Households' Estimates of Home Values: Application to the Reverse Mortgage Decision.' *Real Estate Economics* 46 (3): 655-697. DOI: 10.1111/1540-6229.12197.

Kahneman, D., J. L. Knetsch, R. H. Thaler 1991. 'Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias.' *Journal of Economic Perspectives* 5 (1): 193-206. DOI: 10.1257/jep.5.1.193.

Kish, L., J. B Lansing 1954. 'Response Errors in Estimating the Value of Homes.' *Journal of the American Statistical Association* 49 (267): 520-538. DOI: 10.1080/01621459.1954.10483519.

Kucharska-Stasiak, E. 2013. 'Uncertainty of Property Valuation as a Subject of Academic Research.' *Real Estate Management and Valuation* 21 (4): 17-25. DOI: 10.2478/remav-2013-0033.

Leung, T. C., K. P. Tsang 2013. 'Anchoring and Loss Aversion in The Housing Market: Implications on Price Dynamics.' *China Economic Review* 24: 42-54. DOI: 10.1016/j.chieco.2012.10.003.

Lux, M., P. Sunega, T. Katrňák 2013. 'Classes and Castles: Impact of Social Stratification on Housing Inequality in Post-Socialist States.' *European Sociological Review* 29 (2): 274-288. DOI: 10.1093/esr/jcr060.

Lux, M., P. Sunega, L. Kážmér 2021. 'Simulating Trends in Housing Wealth Inequality in Post-Socialist Czech Society.' *Housing Studies* 36 (6): 885-905. DOI: 10.1080/02673037.2020.1729961.

Melichar, J., K. Kaprová 2013. 'Revealing Preferences of Prague's Homebuyers toward Greenery Amenities: The Empirical Evidence of Distance–Size Effect.' *Landscape and Urban Planning* 109 (1): 56-66. DOI: 10.1016/j.landurbplan.2012.09.003.

Melser, D. 2013. 'How well do Australian homeowners know the value of their home?' *Australian Economic Review* 46 (1): 31–44. DOI: 10.1111/j.1467-8462.2013.00715.x.

Robins, P. K., R. W. West 1977. 'Measurement Errors in the Estimation of Home Value.' *Journal of the American Statistical Association* 72 (358): 290-294. DOI: 10.1080/01621459.1977.10480992.

Rosen, S. 1974. 'Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition.' *Journal of Political Economy* 82 (1): 34-55. DOI: 10.1086/260169.

Sunega, P., M. Lux 2018. 'Rovní v příjmech, nerovní v majetku? Nerovnosti ve vlastnickém bydlení v ČR.' *Czech Sociological Review* 54 (5): 749-780. Retrieved April 20, 2022, from http://sreview.soc.cas.cz/cs/issue/197-sociologicky-casopis-czech-sociological-review-5-2018/3865?culture=en.

Tomal, M. 2021. 'Exploring and modelling the endowment effect in the housing market: evidence from an emerging economy.' *Repozytorium Otwartych Danych Badawczych RepOD*. DOI: 10.18150/HE5BDH.

Trojanek, R., M. Gluszak, M. Hebdzynski, J. Tanas 2021. 'The COVID–19 Pandemic, Airbnb and Housing Market Dynamics in Warsaw.' *Critical Housing Analysis* 8 (1): 72-84. DOI: 10.13060/23362839.2021.8.1.524.

Tur-Sinai, A., L. Fleishman, D. Romanov 2020. 'The Accuracy of Self-Reported Dwelling Valuation.' *Journal of Housing Economics* 48: 101660. DOI: 10.1016/j.jhe.2019.101660.

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Available online at www.housing-critical.com
https://dx.doi.org/10.13060/23362839.2022.9.1.538

Wang, M., M. O. Rieger, T. Hens 2017. 'The Impact of Culture on Loss Aversion.' *Journal of Behavioral Decision Making* 30 (2): 270-281. DOI: 10.1002/bdm.1941.

Wang, Y., Y. Li, Y. Huang, C. Yi, J. Ren 2020. 'Housing Wealth Inequality in China: An Urban-Rural Comparison.' *Cities* 96: 102428. DOI: 10.1016/j.cities.2019.102428.

Windsor, C., G. La Cava, J. Hansen 2015. 'Home price beliefs: Evidence from Australia.' *Journal of Housing Economics* 29: 41–58. DOI: 10.1016/j.jhe.2015.05.002.

Yemtsov, R. 2007. 'Housing Privatisation and Household Wealth in Transition (No. 2007/02).' *WIDER Research Paper*. Retrieved December 10, 2021, from https://www.wider.unu.edu/sites/default/files/rp2007-02.pdf.

Tomal, M. 2021. The Impact of the COVID-19 Pandemic on the Private Rental Housing Market in Poland: What Do Experts Say and What Do Actual Data Show? DOI: 10.13060/23362839.2021.8.1.520.