PRICING PATTERNS ON THE DANISH HOUSING MARKET

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ABSTRACT

Using available data on the Danish housing market from 2016, we looked at the sale process extended with supply and liquidity data. We focused on the behaviour of sellers and found that urbanites perceive the market differently than rural dwellers, and that this perception is reflected in their pricing mechanism as described by the so-called Perception Measure. We found that there is a significant relationship between the initial listing price and the actual sale price. We quantified the underlying factors which determine the perception of the seller by also creating the seller attitude measure. Housing markets are dependent on local factors so intensively that we cannot use a one-size-fits-all solution to describe, analyze, or for that matter regulate them.[1]

JEL codes: R31, C25, C35, C38, G21, G41

Keywords: empirical analysis, housing market supply, seller perception measure, seller attitude measure, type of housing, location of housing, initial listing price, actual sale price, real estate sale process

1 INTRODUCTION

One of the essential characteristics of what constitutes high-quality covered bonds is the availability of highly granular trading data of real estate, validating the calibration of risk parameters for the covered bonds and issuing institutions in question (EBA, 2016; IMF DK FSAP, 2014). Bearing this in mind, we set out to analyze the available data in the globally largest market for covered bonds of notably high quality, the Danish market (ECBC, 2017). This article is part of an overall study exploring the unique features of European covered bonds, leading towards further analysis of possible explanations for their stable performance during the most recent financial crisis.

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Covered bonds are unique capital market instruments, fixed-income securities and dual-recourse[2] debt instruments, issued by a bank (financial institution with a banking licence) pursuant to a special regulatory regime and with special public supervision, in addition to the general banking supervision. The underlying asset is – with very few exceptions – real estate.
Our main aim was to put the available empirical data under scrutiny and to run a number of different analyses (amongst others relationship analysis between variables, regression, cluster analysis, factor analysis, multidimensional scaling, correspondence analysis) to see if there is any relevant robust findings based on this data. We designed the series of analyses in a way that it all targets to scrutinise the observations, thus the conclusions should be understood based on all steps not focusing only one or another analysis. The importance of the study is that it finds that there is a measurable difference between pricing of urban and rural areas. We also find it important that there is a relationship between the initial sale price and the final sale price. Looking at the related literature introduced below in this article, we find that none has approached the pricing differences from the angle this study did and none has shown the above mentioned findings.

1.1 Terminology, scope, and hypothesis of analysis

Residential real estate represents the most significant share of most valuable assets of the general population (see *Tracy–Schneider*, 2001; *Granziera–Kozicki*, 2015), and, according to *Leamer* (2007), also a significant – and underestimated – share of business assets. As Leamer (2007) points out, eight out of ten post-war recessions in the US were due to housing shocks. Hence, it is interesting to see precisely how people judge the value of their property, i.e. how perceptive they are.[3] In other words, how negative (or [over]pessimistic) or positive (or [over]optimistic) people are based on the relationship between the sale price when they put their property up for sale (initial listing price), the sale price requested at the end

2 "Covered bonds are debt obligations issued by credit institutions and secured against a ring-fenced pool of assets to which bondholders have direct recourse as preferred creditors. At the same time, bondholders remain entitled to claim against the issuing entity as ordinary creditors. This double claim against the cover pool and the issuer is referred to as the 'dual recourse' mechanism." Proposal for a directive, COM 2018 (94) on the issue of covered bonds and covered bond public supervision and amending Directive 2009/65/EC and Directive 2014/59/EU and COM 2018 (93), p.2.

3 In Denmark, the typical selling process is as follows: The property owner engages with a real estate agent after running a tender to determine the value of the property from two or three agencies. Real estate agents are bound by law with the liability of negligence to act in good faith. During the sale process, it is possible to change the listing price, but it should be noted that in practice this is a negative change. The listing price at all stages during the sale process is officially registered, as is the actual sale price.

of the sale process (final listing price), and the price at which the given property was actually sold (actual sale price). We have to be cautious, however, in using the terms optimistic and pessimistic in describing the perceptions of microeconomic market players. *Abildgren* et al. (2018) look at the relationship between macroeconomic environment "overoptimism" and housing price developments, namely bubbles and the recent financial crisis. In this article, we study local and regional behavioural differences at the same point in time. As the country's macroeconomic conditions are equal or close to equal in this short period, in a small open economy such as Denmark, it seems defensible to assume that the macroeconomic environment is evenly distributed across the country, and hence that differences in pricing behaviour are not related to differences in the macroeconomic environment. Abildgren et al. (2018) use optimism/pessimism as relational notions in the sense that their verification depends on the concrete definition and the relation of that definition to the individual(s)/behaviour being characterized.

Based on our market observations, we hypothesise that housing markets are significantly dependent on local factors and that there is a difference in the behaviour of market actors between intercultural smaller regions, and thus between urban and rural markets, and between owners of different types of property. We suppose that the differences are incorporated in the price formation of the seller during the process of selling a property.

So far no similar tests have been conducted on how the location and characteristics of a property can influence the pricing of the real estate in question; therefore we ran a wide range of analyses and built a model to test this market pattern.

Although the best way of describing the price perception of sellers in our analysis would be by defining optimism/pessimism measures, we will call this the perception of the seller regarding their property, i.e. the Perception Measure (PM), which is expressed as the difference in price between the actual and initial listing price. The reason for doing so is that, in our belief, this perception is not only targeting price perception but includes a set of behaviour and culture-related aspects. This argument is indirectly underlined by *Han–Strange* (2014; 2016), who note that although the institutions and settings are broadly similar in US markets, different markets experienced the recent boom and bust of the same origin quite differently. We follow the advice of Leamer (2007) and *Thaler* (2016), promoting an evidence-based approach in building knowledge on economic markets. In this light, we analyze the available data of a well-established housing market and shed light on the underlying patterns.

The questions to be looked at here are these: Is there a difference between the behaviour of people in the city (urbanites) versus people in the countryside? And is there any behavioural difference depending on the type of residential property (house, flat or vacation home)? In addition, we are wondering what factors represent overvalued and undervalued residential properties in terms of their price,

location and type. We also included liquidity and supply-related factors in the analysis to see if their impact on the PM is quantifiable.
We expect that there is a difference between the behaviour of people in the city (urbanites) and people living in the countryside. Based on the findings of *Haurin* (1988) and on plain human intuition, we also expect that the rate of difference is distinct depending on the type of property (house, flat or holiday home). We also expect that, based on logical reasoning, property sellers are affected by the information indicated on supply-related measures, such as how much time the given property spent on the market before it was sold or withdrawn. In other words, adjustments in the price should be made in the longer term based on feedback from the market (*Horowitz*, 1992; *McGreal* et al., 2009; *Knight*, 2002; *Turnbull–Zahirovic-Herbert, 2011).*

1.2 Related literature

Looking more closely at the behaviour of property sellers based on classical economic theories, homo economicus takes account of all circumstances in both the short and long term and comes up with a price incorporating all this information, which is the optimal choice. However, we expect that we can falsify this – in this case, too – based on data showing that only short-term factors affect how realistic property sellers are in their judgement. This is consistent with *Damen* et al. (2016), who with their ability to pay (ATP) measure demonstrate that the buyer focuses on the short-term measure of their immediate payment ability. At the same time, we would caution that there are cultural differences that may have a bearing on property pricing dynamics when comparing markets, such as labour mobility or family ties to property. These factors, which we have not looked into here, should, in our view, be borne in mind when carrying out research into comparative property price dynamics.
There are different streams of research regarding property price data. Below we provide a brief overview of the studies relevant to this article. Most studies have a mixed approach and look at different perspectives based on the data at hand. Given the 2007 financial crisis and its causal link to a property value decline, there has been an overwhelming increase in research in this area.
Leamer (2007), in a highly readable and humorous article, looks at housing and the business cycle, and concludes – provocatively – that housing developments can by and large explain the business cycle. The main point is that housing price research should be further advanced, and not least, that its importance should not be overlooked.
Cardella–Seiler (2016) conducted an experimental study, utilising differences in list price strategy to see how they affect the final sale price. Of particular interest

is their finding that list price strategy can impact negotiations. They find that high precise pricing leads to the highest final sale price, observing: "*Most notably, our results suggest that setting precise prices for these negotiable goods will result in the least aggressive negotiation behaviour by buyers and, consequently, yield the highest final sale prices*" (p. 73).

Cerutti et al. (2017*)* studied linkages between property prices and credit policy, and found that loosening credit conditions lead to a credit expansion, which is then again linked to house price booms. At the outset is the desire to lift general housing conditions for populations, leading to government incentives for increasing access to housing finance through different channels. The study of data from more than 50 countries found strong support for a link between credit conditions and house prices. On the other hand, they found that house price booms in general also tend to coincide with general credit booms, not only linked to housing credit. In addition, this study found a link between financial regulation and house price developments. In particular, it singled out two factors: the loan-to-value (LTV) ratio, and personal recourse (personal liability for the mortgage debt, in addition to the security in the property): "*First, the higher the maximum observed LTV, the higher the probability of a house price boom. Second, the presence of full recourse seems to lower the probability of real estate booms (this is probably capturing borrowers' higher risk exposures in overvalued house markets when they are subject to full recourse)*" (p. 2).

Damen et al. (2016) looked at the link between the funding cost of a residential property (mortgage characteristics) and house price developments. Whereas some house price models look at debt-to-income (DTI) or price-to-income levels, the authors developed another measure, the borrower's ability to pay (ATP), which incorporates the trend in interest rates, changes in mortgage deductions and other mortgage characteristics. They argued that a mortgage is a long-term house price fundamental, claiming to find convincing evidence by means of cointegration tests, Granger causality, and elasticity of house prices with respect to ATP close to one. This study, in our view, underlines that buyers are more short-sighted in their approach to property pricing than would follow from the homo economicus theory. This short-sighted behaviour is underlined by *Berlinger* (2017), showing that a significant portion of borrowers choose an extremely short interest rate period based on minimizing the widely used annual percentage rate of charge (APRC), thus – unintentionally – running into excessive risks. Interestingly, Haurin et al. (2013), when looking at property price dynamics before and after the financial crisis, found that pricing is also affected by buyer expectations of future price developments, but with a difference between short-term bubbles and long-term rises. In our reading, the research of Haurin et al. (2013) also seriously questions the ability of the ordinary buyer to act in accordance with homo

economicus predictions, suggesting – insufficient – modifications to the general models of house sale pricing models to try to account for the opportunistic behaviour in housing market bubbles.

Granziera–Kozicki (2015) quickly came to the liberating recognition – fully in line with most recent literature – that "*large movements in house prices, like the recent US boom and bust episode, are hard to generate in standard macroeconomic models with fully rational expectations*" (page 152). Using extrapolative expectations as a substitute for rational expectations, the authors developed an alternative model to explain US property price movements in 1987–2011. The authors found that the data also supported their model, but underlined that their model adds one factor to the development of more advanced housing price models. The article thus further underscored the insufficiency of existing housing price models, as well as the importance of non-rational elements in housing price research.

Han–Strange (2016) looked at the role of the asking price (in this article, listing price) in a house sale, theoretically as well as empirically. This highly theoretical article looked more at developing a directed search model asking what, if any, is the relevance of the asking price. Their findings are of limited reach, and as they themselves admit: *"It goes without saying that there are other aspects of asking price that the paper has not considered. Behavioural aspects of housing transactions are perhaps the most important of these"* (p. 129).

Kusan et al. (2010), while acknowledging that finding property prices is inherently difficult, tried to apply a fuzzy logic model to new residential development pricing in a narrow urban area in Turkey using heuristics based on geographical determinants. Even if the authors admit that their model is not generally applicable, they recommend continued research on advanced housing price models as a means of advancement.

Leung–Tsang (2013) tried to explain housing price dynamics by looking at anchoring and loss aversion. The effects they examined were the previous trading price of a house on the next transaction (anchoring), as well as the predisposition of sellers to sell in a positive market (loss aversion). While the authors do not claim that anchoring and loss aversion explain housing price dynamics in Hong Kong in general, they show that they do influence pricing. Interestingly, though, the authors also included the probable effect of a new regulatory framework (stamp duty), concluding that the regulatory framework will have an effect on property pricing.

Madsen (2012) took on the task of developing a behavioural model of house prices, using OECD house price data, in essence delivering the theoretical framework for a repayment model of house prices that is based on the principle of affordability. The author described the model by saying that "*it is shown that house prices are determined by the nominal mortgage interest rate, the principal repayment, the*

down payment, the after-tax disposable income of house buyers and house owners, financial innovations, and the net flow of potential house owners into the housing market" (p. 22).[4] The author validated the model using data from 18 OECD countries and found the outcome in favour of the developed affordability model over traditional models.[5] In his earlier study [Madsen, (2009)], the author took a much more fundamentalist approach, using a Tobin's q approach presupposing perfect elasticity in the housing market, among others, to account for tax effects on housing prices. These thoughts seem to have been abandoned with the development of the newer model.

De Wit – van der Klaauw (2013) underlined the importance of the fact that in used residential house sales (as is mostly the case), the seller holds proprietary information and hence there is an information asymmetry. Using data from the Netherlands, they showed, perhaps not intuitively or surprisingly, that list price reductions tend to either increase sales or the withdrawal rate of properties from the market.

2 DESCRIPTION OF DATA, VARIABLES, AND THE RELATIONSHIP BETWEEN VARIABLES

2.1 Data source and general description

Finance Denmark (FD) maintains a vast, publicly available[6] database of housing data based on information collected from market participants, i.e. Danish mortgage banks. The data is supplemented with data from the Danish central bank (Danmarks Nationalbank, DNB) and the Danish statistics agency (Danmarks Statistik, DST).

4 As Madsen (2012) explains: "*The repayment model is behavioural in the sense that house buyers fail to acknowledge that inflation lowers the real value of debt and, as such, is consistent with the notion of money illusion (Shafir et al., 1997). Thus, house buyers are willing and able to take larger loans in periods of low inflation and low nominal interest rates than in periods of high inflation and high nominal interest rates because nominal mortgage expenses per dollar borrowed are lower. Thus, the repayment model deviates from conventional house price models in which house prices are determined entirely by the intertemporal decisions of consumers, by the present value of rent/housing services, or by the replacement costs of houses (Tobin's q models)*" (p. 22).

5 Madsen (2012), among his highly interesting findings, also admits the data incomparability for the years 2001–2006: "*However, the model could not account for all the increase in the period 2001–2006, which points toward untestable factors such as financial innovations that lowered the sum of interest and principal repayments as predicted by the repayment model but not testable in the estimates due to the lack of data, easier access to credit, and psychological factors*" (p. 35).

6 https://www.realkreditraadet.dk/en/statistics

The latest end-of-year available data is for Q4 2016, which contains 33 observations[7] that cumulate 17,341 property trades from that quarter[8] and consist of the average square metre prices (in DKK) at which residential real estate was put up for sale (initial listing price), the last publicly listed price before the sale of the property (final listing price), and the actual sale price of the property differentiated across 11 sub-regions (provinces) of Denmark and across three types of property: house, flat, and holiday home.[9] Only the capital region represents fully urban areas, whereas seven other sub-regions are rural areas. We have further data on property supply.

Although the data may seem restricted, due to using an average for the given granularity, this further underlines their comparability. Contrary to Shimizu, C., Nishimura K.G., Watanabe, T., (2015), we are not facing comparability problems due to the fact that the prices collected at different stages of the selling process of the property originate from different data providers.

2.2 Variables

Based on the available data described above, the following variables have been put under scrutiny:

- Initial listing price (IBP, *I*)
- Final listing price (FBP, *F*)
- Actual sale price (AP, *A*)
- Location of the property (location, *l*): (region, either urban (1) or rural (0)
- Type of property (type, *t*): House (1), flat (2), or holiday home (3) and dummy variables: House *(e)*, Flat (*a*), Holiday Home (*y*)
- Excess Supply (excess supply, *S*): difference between number of newly offered properties and number of properties leaving the market due to sale or withdrawal in the given period of time.
- Relative Excess Supply (relative excess supply, *s*): % difference between number of newly offered properties and number of properties leaving the market due to sale or withdrawal in the given period of time.
- Number of days on market (Nr of days On, *n*)

7 In the case of some variables we have only 31 observations due to the fact that the capital region does not have holiday homes.

8 See Statistics Denmark (DST), https://www.statistikbanken.dk/

9 Method description of square-meter price calculation is available (in Danish) at http://finansdanmark.dk/toerre-tal/boligstatistik/definitioner-og-metode/datagrundlaget-for-statistikken/

- Number of days since off the market (Nr of days Off, *f)*
- Number of newly offered properties (New properties, *p*)
- Number of properties leaving the market (Nr leaving, *o*)
- Number of properties withdrawn without selling (Withdrawn, *w*)
- Perception Measure (PM, *P*): difference between the initial listing price and actual price, which gives a measurement of how negative, or positive, people are based on the relationship between the sale price when they put the property for sale and the price at which the given property was actually sold.
- Relative Perception Measure (RelPM, *Π*): relative difference between actual sale price and initial listing price, showing percentage change in price compared to the initial listing price.

Table 1
Summary of basis variables

Name of variable	Short name	Type of variable	Number of observations	Minimum value	Maximum value	Mean/ Modus	Std. Deviation	Normal distribution assumed
Initial listing price	Initial Price	Scale	31	6943	37508	16985.00	7282.923	yes
Final listing price	Final Price	Scale	31	6715	36775	16437.13	7187.141	no
Actual price	Actual Price	Scale	31	6471	36049	15702.35	7086.740	no*
Location: urban, rural	Location	Categorical	33	0	1	0	.452	not relevant
Type: house, flat, holiday home	Type	Categorical	33	1	3	no modus	.829	not relevant
Excess supply	Excess Supply	Scale	33	18	16029	4347.27	4887.932	no
Relative difference between estimated nr of properties new and leaving	Relative Excess Supply	Scale	33	1.89	29.00	7.1146	5.48410	no**

Name of variable	Short name	Type of variable	Number of observations	Minimum value	Maximum value	Mean/ Modus	Std. Deviation	Normal distribution assumed
Number of days on market	Nr of days On	Scale	33	77	669	301.24	157.214	yes
Number of days since off the market	Nr days Off	Scale	33	62	569	245.15	133.506	yes
Number of newly offered properties	New pro-perties	Scale	33	8	5821	1619.15	1772.519	no
Number of properties leaving the market	Nr leaving	Scale	33	1	664	198.09	201.834	no
Number of properties withdrawn without being sold	With-drawn	Scale	33	-62	559	159.09	175.746	yes
Perception Measure: Difference between actual sale price and initial listing price	PM	Scale	31	–2531.00	–472.00	–1282.6452	577.37057	no
Relative Perception Measure: % difference between actual sale price and initial listing price	RelPM	Scale	31	–.15	–.03	–.0811	.03388	Yes

Notes: * The variable can be considered as following normal distributions with transformation
** Relative Excess Supply follows a lognormal distribution

Table 1 above summarizes the main characteristics of the variables. We tested normality and included, in the last column of Table 1, whether the normality assumption of the variable in question can be assumed. When testing normality of the variables we looked at the skewness and kurtosis and used the Shapiro–Wilk test. However, in some cases we also accept the outcome of the Kolmogorov–Smirnov test as underpinned by *George–Mallery* (2010), who say that for the values of asymmetry for the kurtosis -2 and 2 are considered acceptable in order to prove normal univariate distribution.

In our analysis, we use PM and RelPM as the measure of a certain behaviour of property sellers. We name this measure as the market perception measure of the property seller. The greater the difference between the initial listing price and the actual sale price, the more we consider that the seller is deviating from a realistic picture of the property market regarding the sale price of their property. We could use this measure with the symbol "-" to mean a positive perception (in other words an optimistic judgement of the market), when the actual sale price is lower than the initial listing price, and "+" meaning a negative perception (in other words a pessimistic judgement of the market), when the actual sale price is higher than the initial listing price. Although there are markets where both cases are possible (e.g. U.S. markets), in our analysis the distance (absolute value of PM and RelPM) from the realistic market judgement (represented by the actual sale price) is the primary focus. It should be noted that in this data set – the Danish case – the initial listing price is always greater than the actual sale price; in other words, PM and RelPM have negative values.[10] There are two underlying behavioural reasons for this, focusing on the "perception" of the seller, which we have to differentiate from theories which assume that prices are to encourage visits (for example, *Green–Vandell*, 1998 and *Arnold*, 1999) or are set as ceilings (for example, *Chen–Rosenthal*, 1996):

1. The property sellers know their position on the market and are trying to set the price higher, thus there is a negotiation process calculated in the initial listing price as described by Chen–Rosenthal (1996) and also accepted by Han–Strange (2016), though not exclusively (in this case, the classical model fails on the reservation price theory). We call this the negotiation impact (showing that the property seller intentionally keeps the price high in the beginning).

10 The fact that in the dataset the initial listing price is always greater than the actual sale price is our observation. It is not an inherent requirement that it has to be like this. Through our research we found that although it is not common to have a positive difference between the listed and the actual sale prices, it can happen. In our model, we do not think this is an important factor. Nevertheless, we preferred to build an analytical strategy which could be equally useable for cases of positive price difference.

2. The property owners do not know other sellers' and buyers' positions on the market, thus they set a price based on their best knowledge. Here the basic concept of perfect information is falsified. We name this the confidence impact (showing the lack of confidence of the property sellers due to a lack of information).

These reasons are important as we do not assume that these factors are intentionally "calculated" by the seller. It has to be noted that it makes a difference whether the real estate agent is a regulated business; in other words, if its operations involve legally binding consequences. In Denmark, real estate agents are obliged to perform their tasks in good faith and with due diligence, including the valuation of the property, which obviously will have an impact on setting the initial listing price. However, we have not looked at the role of the real estate agent in these markets for two reasons. First, the real estate agent in this case provides "only" a residual knowledge of market circumstances, which is incorporated in the seller's perception. And second, there is no available data on real estate agents' operations.

Looking at the data, we can observe that these two above-mentioned reasons are both present as factors. The question might be raised of whether it is true that the greater the difference, the higher the effect of the negotiation impact; in other words, the greater the absolute value of the market judgement measure (or we could say the more optimistic the property sellers are at the beginning of the sale process).

We analyzed the impact of the location and type of property on the market judgement of property sellers and looked to determine what factors define this market judgement. First, we looked at the relationships between our variables (*Section 2.3*) listed in this section in order to be able to develop a regression model (*Section 3*). We looked for groups of variables that can define the different underlying factors by running a cluster analysis, factor analysis, and multidimensional scaling (*Section 4*). Lastly, we reached our conclusions (Section 5.).

2.3 Relationships between variables

According to *Szüle* (2016), the method of testing relationships between different variables is decided based on whether the variable in question is a scale or a categorical variable. In the case of two categorical variables, we used a cross-table analysis. Testing the relationship between a scale and a categorical variable was conducted either with Kruskall–Wallis, Mann–Whitney, or with the independent t-test, depending on the distribution of the scale variable. Testing the relationship between scale variables, we calculated the Pearson correlation matrix. *Table 2* below summarizes our findings.

Table 2
Relationships between variables

		RelPM	Location	Type
% difference between IBP and AP/Relative Optimism indicator	RelPM			
Location: urban, rural	Location		*	*
Type: house, flat, holiday home	Type		*	*
Initial listing price	Initial price	medium	$p^{Mann\text{-}Whitney}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.30$
Final listing price	Final price	medium	$p^{Mann\text{-}Whitney}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.30$
Actual price	Actual price	strong	$p^{Mann\text{-}Whitney}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.23$
Change in initial listing price compared to previous year	Initial price t-1	medium	$p^{Kruskall\text{-}Wallis}_{L}=0.04$	$p^{Kruskall\text{-}Wallis}_{L}=0.48$
Change in Actual price compared to previous year	Actual price t-1	medium	$p^{Kruskall\text{-}Wallis}_{L}=0.09$	$p^{Kruskall\text{-}Wallis}_{L}=0.33$
Relative excess supply	Rel excess supply	strong	$p^{Kruskall\text{-}Wallis}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.09$
LN Relative excess supply	LN Rel excess supply	strong	$p^{Mann\text{-}Whitney}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.09$
Number of days on market	Nr of days On	strong	$p^{Mann\text{-}Whitney}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.07$
Number of days since off the market	Nr days Off	strong	$p^{Mann\text{-}Whitney}_{L}=0.00$	$p^{Kruskall\text{-}Wallis}_{L}=0.00$

		RelPM	Location	Type
Number of newly offered properties	New properties		$p^{Kruskall\text{-}Wallis}_{L}=0.40$	$p^{Kruskall\text{-}Wallis}_{L}=0.00$
Number of properties leaving the market	Nr leaving		$p^{Kruskall\text{-}Wallis}_{L}=0.52$	$p^{Kruskall\text{-}Wallis}_{L}=0.00$
Number of properties withdrawn without being sold	Withdrawn		$p^{Kruskall\text{-}Wallis}_{L}=0.39$	$p^{Kruskall\text{-}Wallis}_{L}=0.00$
	there is no significant relationship between the variables		there is a relationship between the variables	

Note: * In the Copenhagen area there are no (or only very few) holiday homes. In this case, there is some kind of a negative relationship between 'type' and 'location.' However, we consider this relationship insignificant.

Based on this relationship analysis, we focused our research first on building up a model based on regression using explanatory variables which show a medium or strong relationship with the Perception Measure. Second, given that 'Location' and 'Type' variables can be considered as independent variables, we were able to use them for further grouping variables of our analyses as discussed further below. The relationship of these categorical variables with the listed scale variables above also directed us towards running cluster and factor analyses as appropriate methods.

3 PERCEPTION MEASURE

Searching for the explanatory factors in house sellers' perceptions of the market, we built up a linear regression model. We ran a number of different models and different methods. Due to multicollinearity, we decided to trust the outcome of the stepwise approach (Kovács, 2014) and concluded the following model:

$$\Pi = -0.021 - 0.408\, f - 14.375\, I + 14.065\, F - 0.246\, y^{11}, \quad (1)$$

where Π is the relative perception measure, f is the number of days since the property is off the market, I is the initial listing price, F is the final listing price and y indicates if the property is a holiday home or not.

11 The standard errors of the coefficients are 0.064, 0.019, 2.906, 2.901 and 0.128 respectively.

With the exception of *y*, the coefficients of the variables above are significant within a 5% confidence interval. However, as Kovács (2014) highlights, multicollinearity will modify the confidence interval of the coefficients. Therefore, we could consider the type of the property and – particularly in the case of the holiday home owner – the impact on their optimistic behaviour. This is absolutely logical, as the holiday home represents a luxury wealth item, therefore its impact on household financial decisions should be a smoothing factor.

Looking at the standardized coefficients of the regression model, it is clear that the initial listing price has a more positive impact on the optimism of the property seller than the number of days properties spent on the market which have already left the market (i.e. where the sale was successful or the property was withdrawn). This is an important message. We can say that sellers generally perceive their property positively vis-à-vis the market, i.e. they are generally optimistic, as the actual sale price is always lower than the initial asking price. It is important to highlight that there is ample U.S. research on markets where "negotiating the price up" is a normal – although minority – case (Han–Strange, 2016), or Shimizu–Nishimura–Watanabe (2017). This contradiction carries a significant message about housing market behaviour; namely, that it is absolutely incorrect to compare housing markets with different cultural backgrounds, even if the methodology used is the same. Due to different behavioural aspects, the results of such analyses on national or even regional markets should be interpreted with caution. The greater the initial listing price, the bigger this positive perception. However, the final listing price shows an interesting correlation. The higher the final listing price, the lower the perception. In this latter case, we have to highlight that the two explanatory variables are not linearly independent. Thus, we excluded the final listing price from the model, which – with the stepwise method – resulted in the following model:

$$\Pi = -0.066 + 0.317\, I - 0.735\, y,^{12} \qquad (2)$$

where *P* is the relative perception measure, *f is* the number of days since the property is off the market, *I* is the initial listing price, *F* is the final listing price, and *y* indicates if the property is a holiday home or not.

This clearly shows that the only variables impacting the perception of the property seller are the initial listing price and whether the property is a holiday home or a primary residential property serving as a home. In this case, the impact of the initial listing price is significantly smaller than in the first case.

The constant indicates an interesting observation. If we are looking at a residential property with no initial asking price (for example, the house owner does not offer a price when selling the property), then the seller is already starting with the hope of a higher price than is actually realized. Or maybe we can turn it around

12 The standard errors of the coefficients are 0.110, 0.112 and 0.116 respectively.

and say that homo economicus already sets the price higher to allow leeway for negotiation. Checking on the multicollinearity issue, we ran the model without an initial listing price and final listing price and obtained a very similar outcome.

We ran a linear discriminant analysis[13] with the stepwise method to find linear functions of the "predictor" variables that best separate groups based on the perception measure (*Cramer*, 2003; *Rencher–Christensen*, 2012). Consulting the canonical correlation (the % of the variability of the discriminating values is explained by the grouping) and the Wilks' Lambda (the heterogeneity that is not explained by the discriminating function, Kovács (2011), we found the model fits with the grouping variable 'type' acceptable, and with the grouping variable 'location' weak. It should be highlighted, however, that in both cases only one variable was included in the model, and given that – based on George–Mallery (2007) – the results of discriminant analysis may be applied to predict membership in groups (indicated by categories of the grouping variable), it has a strong message: namely, that there is a determinant difference in the initial listing price based on whether the property is located in an urban or a rural area, and that purely seeing the initial listing price gives a good indication of the location. What is more surprising is that the perception measure is significantly determined by the type of the property, which is logical if we think about the weight of the value of the property within the wealth of the property owner and the typical Danish owners of houses, apartments and holiday homes. Looking at the result of the discriminant analysis, we can conclude that the scale of the perception measure on its own already gives a good indication of the type of the property.

4 FURTHER FINDINGS

4.1 Relatively undervalued and overvalued propertie depend on location and type

Building on the suspicion that there are groups of observations which show similarities to each other in relation to price, location and type of property, but show differences compared to other observations, we ran several cluster analyses. We

13 The two main assumptions in the discriminant analysis are, on the one hand, that the independent variables should have a multivariate normal distribution and, on the other hand, that within-group covariance matrices should be equal across groups (Kovács, 2011). The multivariate normal distribution is difficult to test, but can be derived from univariate normality testing methods based on ASHCRAFT(1998). We used Shapiro–Wilk tests as benchmarks, and concluded that the variables 'relative perception measure,' 'relative excess supply,' 'number of days the property spent on the market' and 'initial listing price' should comply with this assumption. It should be noted that while, for the latter, Shapiro–Wilk suggested that the null hypothesis cannot be accepted, looking at the P-P and Q-Q plots, we assume multivariate normality in this case. Testing the equality of the within-covariance matrices, the significance value ($p_{Location}$= 0,174; p_{Type}= 0,101).of the Box's M tests suggests that this condition is met, as the null hypothesis cannot be rejected.

used a hierarchical cluster analysis to clarify the k-means clustering results. We compared the results of the two clustering models and different methods used. Confirming our expectations, we found that the final cluster centres indicate two clean-cut groupings:

1) those property owners in rural areas who have a lower than average positive perception regarding price, and whose properties are staying longer on the market before they are sold or withdrawn (talking mostly of houses and holiday homes), and
2) those property owners in urban areas with holiday properties who have a higher than average positive perception regarding price.

The groups are named as undervalued properties (meaning properties priced with a less positive perception) and overvalued properties (meaning properties priced with a more positive perception), with 20 and 11 observations, respectively.

4.2 Market liquidity is highly dependent on location

Defining the components and factors between the variables supports the findings above. We ran a series of factor analyses (with principal axis factoring and principal component analysis methods). [14]

Indicating the fit of the factoring model (Szüle, 2016), the Kaiser–Meyer–Olkin Measure[15] for model adequacy (0.678) and the anti-image correlation scores suggest that, although not strong, the acceptable model includes the location, the number of days the property was on the market, the initial price and the final asking price. Based on the variance explained by the factors, the only extractable factor is the location of the property, i.e. if it is in an urban or a rural area. If the property is in an urban area, it is listed on the market for a shorter period and higher listing price.

4.3 Location-related Price Indicator (LrPI) and Type-related Sensitivity (TrS)

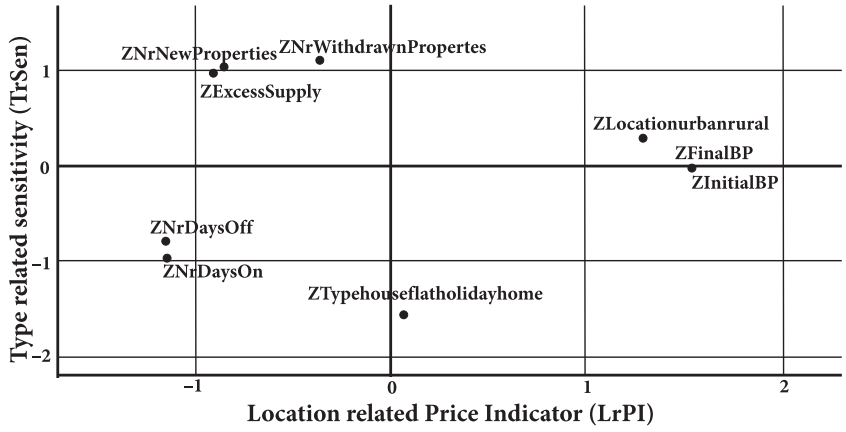
In order to further understand our data, and to understand the similarities and dissimilarities between property sellers who have higher perceptions and those who are more realistic, we placed an observation in a multidimensional space. We analyzed our standardized non-metric variables building upon distances (with

14 In the case of principal axis factoring, factors are extracted from the correlation matrix and iterations continue until the changes in the communalities satisfy a defined convergence criterion. In the case of principal component analysis, uncorrelated linear combinations of the variables in the analysis are calculated.

15 The Kaiser–Meyer–Olkin (KMO) Measure value shows whether partial correlations among variables are small "enough," because relatively large partial correlation coefficients are not advantageous in the case of factor analysis. According to GEORGE–MALLERY (2007), if the KMO value is smaller than 0.5, the data should not be analyzed with factor analysis.

the alternating least squares algorithm, i.e. ALSCAL, ordinal model). Consulting the Stress value (0.014 for one dimension and 0.006 for two dimensional space), we concluded by looking at the two-dimensional model shown in Figure 1.[16]

Graph 1:
LrPI and TrSen as the main dimensions of underlying factors



One dimension is described by location and price (urban location and lower price vs. rural location and higher price), which we call the Location-related Price Indicator (LrPI). The other dimension is described by the type of the property (permanent residential property and higher price, urban location; and vacation property and low price, rural location), which we assign to Type-related Sensitivity (TrSen).

4.4 Seller Attitude Measure (SAM)

To answer – at least partially – the questions set out at the beginning of the analysis, we ran another cluster analysis[17] including prices instead of the Perception Measure, with variable 'type' and then with variable 'location.' In both cases, we examined the clusters for two and three groups, identified in *Table 3* as follows:

16 All variables are standardised and signed with a 'Z' in front of their short names, which are indicated in the summary under 2.2 Variables.

17 The cluster analyses have been conducted with *k*-means clustering, for 1) type, the standardized variable for initial listing price, final listing price and actual sale price and 2) location the standardized variable for initial listing price, final listing price and actual sale price with calibration of k = 2 and k = 3 for both cases.

Table 3
Final cluster centres for correspondence analysis (grey indicating fit solutions)

Clusters	k=2	Prices and type	Chi-square value	Prices and location	Chi-square value
1: OV		Overvalued properties with significant impact on welfare mainly houses		Overvalued urban properties	
2: UV		Undervalued properties with less significant impact on welfare impact: mainly flats and holiday homes	16.948	Undervalued mainly rural properties	5.361
Clusters	k=3	Prices and type		Prices and location	
1: OV		Overvalued properties with significant welfare impact: mainly houses and flats		Overvalued urban properties	
2: UV		Undervalued properties with significant welfare impact: mainly houses and flats	17.057	Undervalued mainly rural properties	4.509
3: RV		Realistically valued properties with less significant welfare impact: mainly holiday homes		Moderately overvalued mainly rural properties	

We conducted correspondence analysis in different settings in order to see if this would provide an extra insight into these variables.

Looking at the Chi square value (one cannot accept the null hypothesis, i.e. that the two variables are independent, as the *p* significance value is 0, smaller than 0.05), we concluded that the correspondence analysis can be interpreted only in cases where clusters are defined based on the three price variables and the 'type'

of the property (OV, UV, RV) with regards to the variable 'location' (Urban – U, Rural – R). In these cases (grey in Table 3), both for two (k = 2) and three (k = 3) groups, we could derive only one dimension which we can define as the Seller Attitude Measure (SAM) towards the property (incorporating the location of the property, its type, and non-measured behavioural factors such as education, welfare, etc.).

This dimension can be described by the following measures:

Seller Attitude Measure in the case of two groups (overvalued – OV, and undervalued – UV properties):

$$SAM_{k=2} = 1.458\ OV - 0.507\ UV + 1.592\ U - 0.464\ R. \quad (3)$$

Seller Attitude Measure in the case of three groups (overvalued, undervalued, and realistically valued properties):

$$SAM_{k=3} = 2.150\ OV - 0.627\ UV + 0.106\ RV + 1.595\ U - 0.465\ R. \quad (4)$$

The SAM formula not only underpins our previous findings that generally urban areas are overvalued and consist of mainly houses and flats (no holiday homes), while rural areas are moderately overvalued or undervalued and have flats and holiday homes, but it also provides us a method to quantify the impact of different sellers' behaviour.

5 CONCLUSIONS

This analysis has looked at possible connections between the initial listing price, the final listing price and the actual sale price of properties in urban and rural areas across three types of residential real estate (houses, flats, and holiday homes). We found that spread levels increase when going from urban to rural areas. It can be said that property sellers' perceptions of their property vis-à-vis the market in the countryside are further away from realistic expectations than urbanites – in the sense that houses tend to be sold at a price closer to the listing price in urban areas. We also looked at the significance of other variables related to supply and liquidity. We found that other factors, such as the time the property spends on the market before being sold or withdrawn, have no significant impact on price perception.

Our analysis was aimed at falsifying the hypothesis stating that housing markets are significantly dependent on local factors and that there are differences in the behaviour of market actors between intercultural smaller regions, thus between urban and rural markets, and between owners of different types of property. We

supposed that the differences are incorporated in the price formation of the seller during the process of selling a property. As shown by the analysis, we are unable to falsify the hypothesis in accordance with the scientific principles of Popperian falsification.

So far no similar tests have been conducted on how the location and characteristics of a property can influence the pricing of the real estate in question, thus we ran a wide range of analyses and built a model to test this market pattern.

There are other factors which could have a significant impact on the Perception Measure, for example media coverage of the impact of the financial crisis (e.g. media coverage might focus on post-crisis price pick-up in urban areas, prompting rural real estate to be listed at higher prices due to the expectations deriving from media coverage).

One unexpected finding that emerged from the analyses was that there seems to be a strong correlation between the initial listing price and the actual sales price. In this sense, one could ask: Is it important to negotiate the initial listing price upwards with a real estate agent? Clearly, the analysis shows that the answer is yes. This is an important observation underpinning the fact that homo economicus is not a perfect characterization of behaviour when it comes to housing market sellers. In addition, it was also unexpected that the price perception of these sellers is independent of the turnover time, or the time the property spent on the market. One would expect that at some point an increase in price would lead to a disproportionately long sales time. This remains for further analysis of the data over time.

Based on the analyses conducted, we identified two groups of property owners: 1) those sellers in rural areas who have a lower than average positive perception regarding price; and 2) those sellers in urban areas, with holiday properties who have a higher than average positive perception regarding price. The groups are named as undervalued properties (meaning properties priced with a less positive perception) and overvalued properties (meaning properties priced with a more positive perception). This conforms with intuition, as in rural areas the number of transactions is potentially significantly lower, thus sellers have less information from the market on property prices. Generally, those who are selling properties in rural areas are those who are deciding to move to urban areas; they thus tend to underestimate the value of their property based on their preferences. In addition, holiday homes represent a part of wealth about which property owners have no continuous feedback with regard to the quality of the home (e.g. because it is inherited), or who use it as an urgent liquidity buffer (i.e. they need to sell it for liquidity reasons, needing to sell fast and therefore sell cheaper). To validate this argument, I believe further research should be conducted on more granular transaction data over time. Along the same lines, the second group of owners

comes from urban areas, in permanent residential properties, who are too optimistic about the value of their properties.

The above-described reasoning was further confirmed as close to 90% of the variance could be explained by one factor, which is the location of the property, i.e. if it is in an urban or a rural area. If the property is in an urban area, it is listed on the market for a shorter period and for a higher listing price. We also ran analyses to identify the similarities and dissimilarities between property sellers who are more optimistic and those who are more realistic. We identified two dimensions: the Location-related Price Indicator (LrPI) (giving further proof of urban location and lower price vs. rural location and higher price) and Type-related Sensitivity (TrSen) (describing permanent residential property and higher price, urban location; and holiday property and low price, rural location).

We also found that there is a determinant difference in the initial listing price based on whether the property is located in an urban or a rural area, and that purely seeing the initial listing price gives a good indication of the location. What is more surprising is that the Perception Measure is significantly determined by the type of the property, which is logical if we think about the weight of the value of the property within the wealth of the property owner and the typical Danish owners of houses, apartments and holiday homes.

To sum up all the above arguments, we created the Seller Attitude Measure (SAM) towards the property (incorporating the location of the property, its type, and non-measured behavioural factors such as education, welfare, etc.), which can be calculated by two different formulas depending on whether we look at two or three groups of property sellers.

Comparing results from other markets (for example McGreal–Adair–Brown–Webb, 2009; Han–Strange, 2016, or Shimizu–Nishimura–Watanabe, 2017), it is clear that housing markets cannot be modelled uniformly. National or even regional differences – in culture, education, etc. – will lead to different behaviour of sellers, thus creating different market characteristics. We suppose that the methodology used for analyzing the market can be based on the same techniques, but interpretation of the results has to be based on thorough knowledge of the given market. In this light, we would stress that European regulators of housing markets – regardless of whether it is the origination or the funding side – have to be cautious about creating one-size-fits-all solutions.

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