

TALLINN UNIVERSITY OF TECHNOLOGY

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**HOW DO GENDER, AGE AND EDUCATION AFFECT
HERDING IN THE REAL ESTATE MARKET?**

Master's thesis

Programme TARM02/13, specialisation Finance

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I hereby declare that I have compiled the paper independently and all works, important standpoints and data by other authors has been properly referenced.

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ABSTRACT

The aim of the thesis is to shed light on the concept of herding and why it should be further analysed in the real estate market and to show if demographic and socioeconomic factor based herding emerges in the Estonian real estate market. Due to the sparseness of existing literature on the subject of herding in real estate specifically, this article analyses literature on herding and associated behavior based on other markets to give the reader a broad view of the subject and why it is relevant in the context of real estate markets and also strives to add to the literature with its' empirical findings on the subject.

To fulfil this aim we analyse Tallinn's, Estonia's capitals', anonymized real estate transaction data from the years 2004-2012 that also includes information on the buyers and sellers gender, age and educational background using primarily the FHW method while also testing herding related hypothesis with various alternative methods.

The FHW method indicates no gender based herding in real estate transactions. However the FHW method does indicate moderate herding amongst people under the age of 26, which is also statistically significantly higher in both of the datasets constructed for this article. Additionally low to moderate herding emerges amongst people older than 55. The absence of a university degree leads to higher herding only in transactions between two single non-commercial parties. Other results concerning educational factors and herding are inconclusive.

Keywords: herding, herding, real estate transactions, demographic factors, socioeconomic factors, FHW method

INTRODUCTION

This thesis was written as an article. The article will be submitted to the Journal of Behavioral and Experimental Finance. According to the journal's information pack for authors there are no specific formatting rules for the submitted article, thus the article itself is formatted partly in accordance with the Tallinn University of Technology's School of Business and Governance requirements in force at the time of writing this thesis. Besides the formatting the article itself is written in accordance with the journal's author's guide, which states the compulsory elements of the article's structure and the recommended length (6000-8000 words).

In the recent past the focus of economists has been shifting from traditional finance, which focuses on the rational human being, efficient markets and utility maximization, towards behavioral finance. Behavioral finance comes into play when we start looking into the often very complex decisions of humans and moving the focus from the question "How?" to the question "Why?".

Although the popularity of the subject of herding is growing in literature, most of it is focused on stock markets whereas the amount of relevant articles in the context of the real estate market is still quite sparse. Due to that this article analyses literature on herding and associated behavior based on a variety of markets to give the reader a broad view of the subject and why it is relevant in the context of real estate markets and also strives to add to the literature with its' empirical findings on the subject. Looking at the possible findings based on other markets it can be seen that there are a multitude of internal (gender, confidence, education, sophistication etc.) and external (other market participants) causes for the emergence of herding behavior and that herding behavior can be linked to times of greater market stress.

The aim of the thesis is to shed light on the concept of herding and why it should be further analysed in the real estate market and to show if demographic and socioeconomic factor based herding emerges in the Estonian real estate market. The author's belief is that the phenomena of herding should emerge in all markets and specifically in real estate due to the investment decision's complexity and importance in most investors' lives and the diversity of participants in the market.

The factors analysed include gender, age in the form of age groups, highest level of obtained degree (no university degree, Bachelor's degree, Master's degree or higher), type of education (economics, IT, real science, other) and subject grade quartiles (math, english, native language). Corresponding to the factors, following research questions are formulated:

- Does gender based herding behavior emerge based on Tallinn's real estate transactions?
- Do people of different age groups display herding behavior in the Estonian real-estate market?
- Is the highest obtained degree a factor that can indicate the emergence of herding behavior in the Estonian real-estate market?
- Can the type of obtained education influence the emergence of herding in the Estonian real estate market?
- How does fundamental knowledge of certain subjects affect the tendency to herd when buying real estate later in life?

To the authors knowledge this exact subject has not been researched in the same way before and that is where the value of this research lies. This article also uses a unique dataset which few other countries can match to analyse the effects of educational variables on herding.

The quantitative research methods used will be the FHW method and several generalized linear models including the logistic regression model and negative binomial model that apply to the data analysed. The data used is provided by the thesis supervisor, who is also the co-author of the written article, and is comprised of the anonymized land register data of Tallinn for the years 2004 to 2012, which is combined with the information on educational variables from the Estonian Ministry of Education and Science. The methods mentioned above are purposefully chosen to best fit the data available for analysis.

The first parts of the article following the introduction of this thesis is the abstract and introduction sections. In the article's introduction section the main reasons for the importance of the subject of herding relative to the real estate market is given with the explanation of this articles contribution to existing literature. This is followed by the synthesis of current literature on the subject and an overview of the methods that have been used to determine the presence of herding in the past. The literature related section is followed by the description of the datasets provided for the analysis and an indepth description of the methodology that is used in this article to determine herding

behavior. This section of the article is finished by the descriptive statistics of the data. After the descriptive data the article moves on to the results of the previously described analysis which in turn is followed by the discussion part of the article. The article ends with a short conclusion section after which the references used in the article are given.

The thesis author's contribution to the article lies in the synthesis of previous literature on the subject of herding and analysis of Tallinn's real estate transaction data in the context of herding and is found in every section of this article. The analysis included researching different methods and determining the fit of the data for those methods. The latter was followed by an independent processing of raw data for further analysis and the calculation of FHW statistics with the statistical testing required to determine the statistical significance of the difference of said statistic's mean values. All of the methods used in this article were conducted by the thesis author. In addition all the figures and tables including their description and interpretations were given by the thesis author and the discussion and conclusion sections have not been edited by the co-author.

The contribution of the co-author of the article who is also the supervisor of the thesis lies in the final edit of the article portion of this thesis. The most significant contribution of the co-author is in the article's abstract and introduction sections, where the co-author condensed the existing material and helped bring more focus on the core value of the article. The co-author also helped distinguish which elements should be in the main text and which elements should be given in the footnotes. The co-author also set the final structure and dictated the approximate visual format of the article including the necessity of the level of information given in the main text, which helped to condense the article to the recommended length.

The author would like to thank her supervisor for providing the data and guidance in the process of writing this thesis and for his contribution in the article that they have written together.

How do gender, age and education affect herding in the real estate market?¹

Anne-Liis Tänav², Tõnn Talpsepp³

Abstract

The paper analyses how gender, age, education and academic abilities affect herding in the real estate market. We use a dataset of residential real estate transactions from 2004-2012 in Estonia containing information on demographic variables and educational backgrounds of buyers and sellers. We use FHW method along with various alternative methods to test for herding. We do not identify gender-based differences in herding, but low to moderate herding among very young and older individuals. Individuals with education in economics tend to herd less than average and academic abilities do not seem to play an important role.

Keywords:

real estate investments, household finance, socio-demographic factors, FHW method, herding

¹ We are grateful to Marko Mölder and Estonian Ministry of Education and Science, Lauri Veski and Innove, for the data and their supportive attitude and efforts for processing our data requests. This work was supported by the European Union through the European Regional Development Fund. Declarations of interest: none.

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1. Introduction

Housing decisions are among the biggest financial decisions which individuals make during their lifetime. Poor decisions can have clear financial consequences on the well-being of households. Numerous studies have identified herding behavior in the stock market which generally results in poor financial performance. Thus, it is important to study whether similar behavior exists in the real estate market as well.

In residential real estate the asset is most likely the dominant asset in the investors' portfolio and may also be worth several times over the owners net wealth (Flavin and Yamashita, 2002). That said, the purchase of real estate is probably one of the most significant decisions of an individuals life (Bucchianeri, 2013). Real estate is a long-term asset in a fixed in location and investors in residential real estate markets are rarely frequent players which can indicate lower level of sophistication in the market (Kinnard, 1968). Real estate has also emergent attributes such as ethnicity based clustering of households (Wyman et al., 2011). It is believed that in complex situations people may use herding as a form of comfort because the probability of making the wrong decision seems smaller if others are making the same decision (Wyman et al., 2011).

Housing and investment decisions into real estate played an important role in the emergence of the last financial crises. During the time real estate prices surged and positive media coverage resulted in more people purchasing residential real estate either for their own use or as an alternative investment. In the rising market conditions such success stories make households think more optimistically about the housing market which in turn provokes new positive stories and boosts the prices (Hott, 2012). Thus, any important financial decisions that are affected by herding can have long-lasting effects. Before the financial crisis of 2007 residential real estate was widely seen as an asset class gaining wider acceptance and interest from individuals, which makes identifying possible herding mentality and factors affecting herding in the real estate market even more important.

Although the popularity of the subject of herding is growing, most of the current literature on subject is focused on the stock market whereas the number of relevant articles in the context of the real estate market is still quite sparse. We provide empirical analysis on how socio-demographic factors and education affect decisions of individuals in the residential real estate market. We use a unique dataset coming from Estonia which consists of all real estate transactions for the period

2004-2012. The period covers the full business cycle including the rapid rise in real estate prices till 2008, the following fast drop in prices, and the stabilization and moderate rise starting from 2010. We focus on residential housing transactions in the capital of Estonia, Tallinn, which is the most liquid segment of the real estate market in Estonia. Transactions in that segment can include purchases for own housing needs as well as real estate investments by individuals.

Along with real estate transactions, our dataset contains demographic information about buyers and sellers along with detailed educational data containing information about area of studies, degrees obtained along with detailed information about exam results in various subjects. Such information enables us to analyse herding based on gender, age, level and type of education, field of studies and academic abilities which can partly serve as a proxy for intelligence.

Our contribution to the literature includes providing empirical evidence of herding in the residential real estate market for an emerging market for the whole business cycle which includes large price swings. Price movements and purchasing behavior for our sample are very similar to most countries where individuals play an important role in purchasing and selling transactions of the residential real estate market.

Furthermore, we add to the literature by using a unique dataset containing detailed information about educational characteristics of individuals in the context of real estate transactions. Due to data availability such information is available only for a limited number of countries. Our conclusions help to shed light how education and intelligence affect herding in the real estate market.

We use the FHW method to analyze herding behavior of various investor groups. From the generalized linear model family, we utilize the logistic and negative binomial regression methods to determine if herd like behavior can be detected. With logistic regression we assess if an investor group's odds of making a transaction is influenced by the number of transactions made by other investor groups in the same timeframe and the negative binomial regression is used to determine if the amount of transactions in time is influenced by different investor groups.

The rest of the article is structured as follows. Section 2 provides an overview of the causes of herding and methodology used to measure herding. Detailed information on the data and methods

is brought in Section 3. We provide results in Section 4, which is followed by the discussion of results in Section 5 and ends with a conclusion of findings in Section 6.

2. Current state of the literature

2.1. Causes for herding

Herding is one of the most research fields in the literature of behavioral finance. Cote and Sanders (1997) define herding as the alteration of ones private beliefs to correspond more with the publicly expressed beliefs of others. It is also defined as imitation behavior that leads to correlated action patterns (Hirshleifer and Teoh (2003) and Gleason et al. (2004)) which are irrational, exuberant and unjustified by fundamental values (Vassilios et al. 2015). Herding behavior has roots in the availability heuristic identified by Tversky and Kahneman's (1974) which means that the overestimation of the likelihood of a recent event fuel a positive-feedback chain and drive the market further away from the balance that fundamental values are meant to create.

Numerous previous studies have tied variables such as age, gender and education to overconfidence and the ability and willingness to take risks. Additionally, research also shows that people tend to under-estimate the odds of negative and over-estimate the odds of positive outcomes (Weinstein, 1980). Bhandari and Deaves (2006) show that women are less overconfident than men because they are less certain in their decisions, formally educated (any field) people are also more overconfident because they percieve themselves to know more than they actually do and lastly that people close to retirement tend to be more overconfident. Barber and Odean (2001) also show that men are more overconfident than women by showing that men trade more. Studies on risk tolerance and aversion show that women are less risk tolerant than men, that younger people and households are more risk tolerant compared to older people, that wealth has a negative effect and income and education have a positive effect on the willingness to take risks (Hawley and Fujii, 1993; Sung and Hanna 1996; Halek and Eisenhauer 2001).

Herding tends to be present in many stock markets all over the world and has a higher probability of emerging in countries with lower levels of sophistication among investors and higher perceived masculinity (Chang and Lin, 2015). Chang and Lin (2015) also found that behavioral pitfalls influence herding more than cultural factors and confirmed that excessive optimism leads to higher herding tendencies. Diaz and Hansz (1997) and Kim and Wei (2002) come to the similar

conclusion that when investors act in a geographically unfamiliar market then they tend to herd more than resident investors.

Vassilios et al. (2015) found herding behavior to be more prevalent in US REITs during the crash regime and several researchers (Gleason et al., 2004; Shin, 2010; Philippas et al., 2013) argue that herding may amplify negative effects in the market. Gleason et al. (2004) finds that varying level of sophistication of investors and the volume of information available can cause herding especially in times when uncertainty increases because during those times it will be safest to act according to the herd.

Herding research in real estate has more focused on return dispersions. Zhou and Anderson (2011) analysed herding behavior in US equity REITs market and find that herding is asymmetric and more likely present in the high quantiles of return dispersion.

Existing literature has not concentrated on the phenomenon in the real estate market and is still in search of the possible root causes of it. Looking at the possible findings based on other markets we can see that there are a multitude of internal (gender, confidence, education, sophistication) and external (other market participants) causes for the emergence of herding behavior and that herding behavior can be linked to times of greater market stress.

2.2 Measuring herding

According to previous literature on the matter of herding there are a few basic models and the rest of the models are variations and improvements on the basic models for assessing herding and similar behavior.

One of the first basic models for detecting herding behavior is the LSV measure proposed by Lakonishok et al. (1992). The Lakonishok et al. model enables to assess herding and positive-feedback trading. The LSV measure measures if investors tend to buy/sell the same stocks at the same time and the logic behind the measure is that if more than half the investors end up on the same side of the market at a given point in time, then herding behavior has taken place. Numerous studies based on the stock market use the LSV measure⁴.

⁴ See for example Wermers (1999), Kremer and Nautz (2013)

The newest and most popular measure based on LSV is the measure proposed by Frey et al (2014), who build on the LSV methodology and propose an improved version of it called the FHW measure. Compared to the LSV measure, the FHW measure is statistically less biased and more consistent especially as the number of observations increases. Frey et al (2014) suggest that the existence of herding can be tested using either the LSV or FHW measure, but the level should be estimated using FHW. Recent studies⁵ have favoured the FHW over the LSV measure. Bellando (2010) suggests that the real herding values are bound by the LSV as a minimum and the FHW as a maximum value because the biases of the methods are influenced in opposite ways and also points out that the FHW method is biased when the expected probability to buy does not equal the expected probability to sell.

The other basic concept that explores the existence of herding is based on monitoring movements in asset return dispersions in response to market activity. Christie and Huang (1995) propose a cross section standard deviation (CSSD) measure which relies on the logic that when herding is present then the price dispersions of individual stocks will reduce due to the similar behavior of market participants. The CSSD measure is extended by Chang et al. (2000) proposing the use of the cross-sectional absolute deviation (CSAD) of returns⁶. A similar concept is further developed by Hwang and Salmon (2003) that accounts for the effects of time series volatility change that can be confused for cross-sectional variance.

3. Data, methodology and descriptive statistics

3.1. Data

We use a dataset from the official land register of Estonia which includes all real estate transactions from 2004-2012. The data is anonymized and processed to remove transactions that are not relevant to the study. We use only transactions of residential real estate for the capital of Estonia, Tallinn. This is the most liquid segment in the real estate market and makes up a large proportion of all real estate transactions in Estonia. This is a sample where herding can be measured with the most accuracy and introduces more homogeneous sample for our purposes.

⁵ Mohamed et al. (2011), Merli and Roger (2013), Bellando (2010)

⁶ Used in studies by Zhou and Anderson (2011), Chang and Lin (2015), Vassilios et al. (2015)

We also remove transactions between two commercial parties or transactions where there are multiple parties associated with both sides of the transaction for in those cases relevant variables such as gender or education cannot be correctly assessed. In addition, transactions where the seller and buyer are the same person are removed. It is also important to note that the data is analysed from the buyers' perspective.

The original division of transactions between different buyer and seller types can be seen in Table 1 below. From the table it can be seen that the following analysis uses 116971 transactions where the demographic variable can be identified for 93472 buy transactions and 73335 sell transactions.

Table 1. Number of transactions by buyer and seller type in original data.

Seller / Buyer	One civilian	Multiple civilians	One commercial party	Multiple buyers, at least one commercial
One civilian	49836	17920	5121	458
Multiple civilians	6785	4769	716	195
One commercial party	36478	9712	14287	735
Multiple sellers, at least one commercial	373	331	372	1741

Notes: Transactions where the seller and buyer are the same person have been removed.

Our educational dataset includes information from the Estonian Ministry of Education and Science. The dataset includes the results of high school final exams and information about each individual's type of education and education level along with university degrees. We use high school final exams to measure individual's academic abilities. Those exams are designed to be at the same level of difficulty for all high school graduates across all years. All data used was first anonymized. The summary of transactions that had education related data is given in Table 2.

Table 2. Summary of transactions related to educational variables.

Variable	Number of type of transactions		% of total type of transactions	
	Buy	Sell	Buy	Sell
Highest degree	33642	14330	36,0%	19,5%
Type of education	21778	9402	23,3%	12,8%
Math grade quartile	11007	2761	11,8%	3,8%
Native language grade quartile	12296	4075	13,2%	5,6%
English language grade quartile	14651	3892	15,7%	5,3%

Notes: The number of transactions by type (buy/sell) related to each educational variable. The percentage of total transactions by individuals of type buy/sell is calculated using the total number of transactions where the buyer/seller could be identified as a single person.

3.2. Methodology

The data available for this study does not contain transaction price data due to privacy restrictions but contains information who bought (or sold) what and when. Thus, we are restricted to the use of the FHW method because it does not require the presence of transaction price data.

According to Frey et al. (2014) the FHW measure is calculated using the second moment, which is also known as the measure for dispersion. The herding measure for class a in time T is calculated with the following formula:

$$FHW(Ta) = \frac{1}{T} \sum_{t=1}^T \frac{(b^{ta} - \hat{\pi}^t n^{ta})^2 - n^{ta} \hat{\pi}^t (1 - \hat{\pi}^t)}{n^{ta} (n^{ta} - 1)},$$

where T is the total number of periods, $\hat{\pi}^t$ is the estimate for the probability of buys in time t, n^{ta} is the number of transactions in time t of class a, and the numerator is the empirical variance minus the expected variance of a binomial distribution with parameters n^{ta} and $\hat{\pi}^t$. b^{ta} is the total number of buys in time t of class a. Looking at the formula above, it can be seen that the highest value for the measure, if $\hat{\pi}^t = 0,5$, is 0,25 (when b^{ta} approaches n^{ta} or zero). The square root of the $FHW(ta)$ measure is comparable to the LSV measure.

The significance of the difference between FHW measures is also tested using various parametric and non-parametric tests based on the normality of the measure's conditional distribution. Since the number of observations (FHW statistics) per group is relatively low (36 quarters) then the Shapiro-Wilk test is used to test whether the distribution of the FHW variable is significantly different from a normal distribution. If the assumptions for a t-test or one-way ANOVA are met, then those methods are used. If the assumptions for parametric tests are not met then a non-parametric alternative such as Wilcoxon rank sum or Kruskal-Wallis test is chosen. If a variable contains more than two groups (such as age) then the pairwise comparison following ANOVA is conducted using the Tukey method and following the Kruskal-Wallis test, a Dunn's test is performed.

Fehr et al. (2002) made an important discovery of human behavior which states that if there is a sufficient number of people in a population with a certain motive, then that will in turn make other individuals take over that same motive. Following that train of thought, we decide to test herd like behavior using methods that have not been specifically formulated to detect herding but can show

if similar behavior can be detected. For this purpose two additional analyses are carried out on selected variables.

We use logistic regression to assess if an investor group’s odds of making a transaction is influenced by the number of transactions made by other investor groups in the same timeframe and for this analysis new variables were created for each transaction that consisted of the number of transactions made by certain type of buyers and sellers in the same quarter. We use the negative binomial regression is used to determine if the amount of transactions in time is influenced by different investor groups. The negative binomial regression model is constructed for each variable separately.

3.3. Descriptive statistics

As the main dataset for analysis, we use the dataset obtained as described before (we call it Dataset1). As a robustness check, we construct an additional dataset which is a subset of Dataset1 and consist of only transactions between two non-commercial parties. Dataset1 consists of 116 971 transactions regarding 88 308 different properties and Dataset2 consist of 49 836 transactions regarding 41 080 different properties. During 2004-2012 26,1% of the properties in Dataset1 and 18,2% of the properties in Dataset2 were sold more than once. The average number of transactions for one distinct buyer in the years 2004-2012 is 1,24 in Dataset1 and 1,12 in Dataset2.

The division of transactions between genders for both datasets is shown in Figure 3 and is quite similar for men and women. The division of transactions between genders has been quite stable in time. Interestingly the proportion of mixed type buyers, categorized as other, has steadily increased (from 16% in 2004 to 27% in 2012) in time. We can see a steady decline in the number of transactions being made by all buyers.

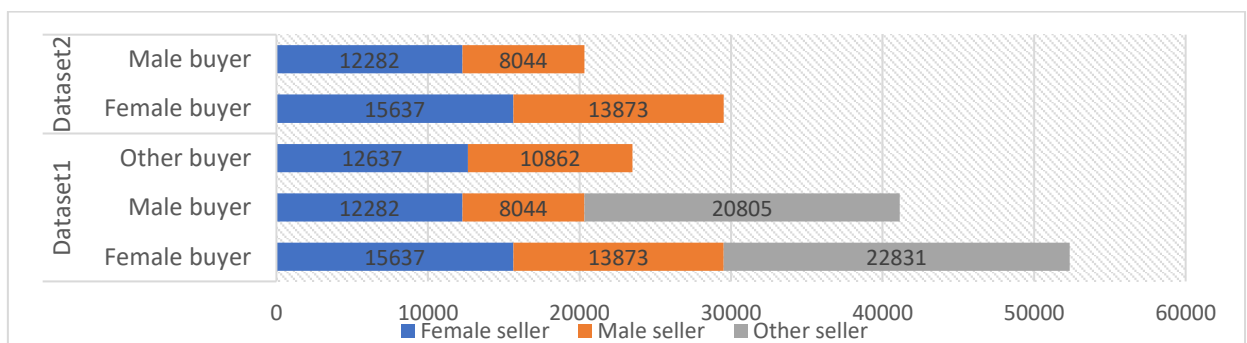


Figure 3. The division of transactions by gender between sellers and buyers.

Notes: The group “other” denotes transactions where one side includes multiple sellers or buyers and commercial sellers or buyers like real estate developers. Dataset 1 includes transaction where

at least one side (buy/sell) of the transaction is made by one civilian, Dataset2 is a subset of Dataset1 where both sides of the transaction are single individuals.

The approximate ages of the buyer and seller were calculated based on the year of transaction and the year of birth of the buyer and seller, respectively and are divided into 5 groups. It can be seen from Figure 4 that a larger number (24,3% in Dataset1 and 31,0% in Dataset2) of transactions were made when the buyer was between 26 and 35 years of age, which is to be expected, since in that age range most young people buy their first homes. The average number of transactions per buyer in different age groups has not changed significantly in time and is similar between age groups.

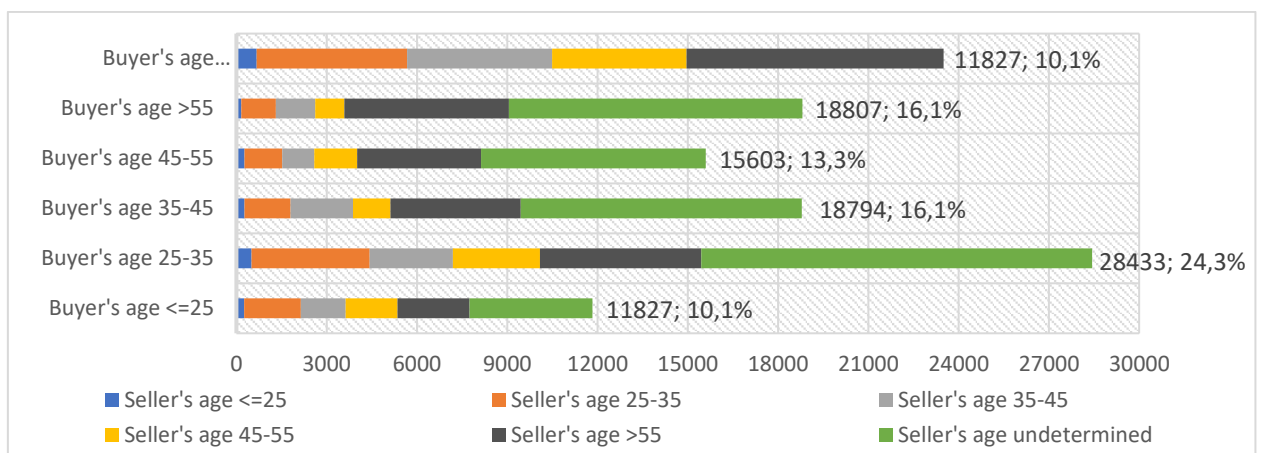


Figure 4. Division of transactions by buyer's and seller's approximate age at the time of transaction.

Notes: The group "age undetermined" denotes the transactions where the age of the buyer could not be determined correctly. The percentages next to the columns denote the proportion of the group's transaction from the total number of transactions in Dataset1 and the age groups total number of transactions in the same dataset is shown before the per centages. The division of transactions for Dataset2 can be seen in the same figure when the reader disregards the transactions where either the buyer's or seller's age is undetermined.

The dataset also includes data on the education of the buyers and sellers. More specifically the level of education (no university degree, bachelor's degree, master's degree or higher), type of education (economics, IT, real science, other) and subject (math, native language and English language) grade quartiles. In the main dataset (Dataset1) 36,6% of transactions that had the information about buyer's highest obtained education were made by buyer's that did not have a university degree, 48,1% by buyers that had a bachelor's degree and 15,4% by buyers that had a master's degree or higher. From the transactions that had the data for buyer's education type 29,9% had an economics related education, 7,4% had an IT related education and only 1,0% had a real science related education. The division is relatively similar in Dataset2. Over 73% of all

transactions associated with education level and type data were made by buyers and sellers that were under the age of 36.

The overall division of transactions between subject grade quartiles is similar in both datasets and between different subjects, with 20,3%-21,8% of said transactions being made by buyers that had a subject grade which landed in the lowest quartile (quartile 1), 22,4%-24,0% were made by buyers that had a subject grade which landed in the second lowest quartile (quartile 2), 25,3%-27,0% were made by buyers that had a subject grade which landed in the second highest quartile (quartile 3) and 28,2%-30,6% of transactions were made by buyers that had a subject grade that was in the highest quartile (quartile 4). Over 97,5% of all transactions associated with grade quartile data were made by buyers and sellers that were under 36 years old.

4. Results

The FHW measure can only be used for transactions where at least on side consists of a non-commercial partie and we use a quarter of a year as the time measure. Thus we obtain 36 FHW measures for the whole sample period that are aggregated for mean scores. The estimate for the probability of buys in time t is $\hat{\pi}^t = 0,5$ for all variables. The significance of the difference between FHW measures was also tested using various parametric and non-parametric tests for either mean or the distribution of the group specific FHW measure based on the measures conditional distribution normality.

The FHW measure for male buyers in Dataset1 is 0,004 and for female buyers 0,005. The same statistic based on Dataset2 is 0,000 for both male and female buyers. Based on the values calculated from both datasets we can conclude that the FHW measure does not indicate the presence of herding based on gender⁷.

For the gender variable two logistic regression models were constructed where the dependent variable was the gender of the buyer and the independent variables were the number of transactions by female, male or other sellers and buyers in the same quarter. Although the independent variables given in Table 5 are statistically significant, the effects are marginal considering the likely shifts

⁷ Since the FHW measures associated with gender are not normally distributed, we use Wilcoxon ran-sum test, which shows that the mean ranks of the FHW measures based on gender are not significantly ($p=0,946$) different.

in the number of transactions per investor group in a quarter. Taking the previous into account we can conclude that the model does not suggest herd like behavior based on gender.

Table 5. Logistic regression model for gender variable

Independent variables	Dataset 1		Dataset2	
	Odds ratio	z-value	Odds ratio	z-value
Transactions by female sellers in quarter	-	-	1,002*	4,61
Transactions by male sellers in quarter	-	-	1,001*	5,58
Transactions by female buyers in quarter	0,999*	-15,85	0,998*	-7,34
Transactions by male buyers in quarter	1,001*	14,82	-	-
Constant	0,768*	-11,21	0,667*	-9,68

Notes: Odds ratios and z-values from logistic regression for buyer's gender variable (dependent variable, base value is "male") in Dataset1 and Dataset2. The independent variables are given in the first column and comprise of the number of transactions. The * denotes values that are statistically significant at the 5% level. The final logistic regression model for gender was statistically significant in both datasets ($p < 0,000$).

The negative binomial regression models for gender, where the dependent variable was the number of transactions and the independent variables were the genders of buyers and sellers was statistically significant in both datasets. The model (see Table 6) shows that the rate of transactions is lower both when the buyer or seller is male compared to when they were female since the IRR is below 1.

Table 6. Negative binomial regression model for the number of transactions in time by gender

Independent variables	Dataset 1		Dataset2	
	IRR	z-value	IRR	z-value
Base value: Buyer is female				
Buyer is male	0,748*	-6,49	0,676*	-9,00
Buyer is other	0,834*	-3,50	-	-
Base value: Seller is female				
Seller is male	0,798*	-5,06	0,763*	-6,20
Seller is other	1,610*	9,16	-	-
Constant	437,029*	146,80	469,656*	160,00

Notes: Incident rate ratio (IRR) and z-values from negative binomial regression for the number of transactions (dependent variable) in Dataset1 and Dataset2 by gender. Transactions were aggregated by quarter year, buyer's gender and seller's gender. The independent variables are given in the first column. The * denotes values that are statistically significant at the 5% level.

Source: Author's calculations

Moving on to the analysis on the effect of age it can be seen from Table 7 that the FHW statistic indicates moderate to strong herding, that is statistically significantly higher than the other age

groups, in the lowest age group in both Dataset1 and Dataset2. The FHW statistic indicates low to no herding in the other age groups in datasets Dataset1 and Dataset2⁸.

Table 7. Age groups and respective FHW statistic values

Variable	Statistic	Age group <=25	Age group 25-35	Age group 36-45	Age group 46-55	Age group >=56
Dataset1	Mean	0,125	0,028	0,007	0,004	0,019
	Std.Dev	0,016	0,011	0,008	0,007	0,015
Dataset2	Mean	0,123	0,017	0,001	0,000	0,042
	Std.Dev	0,022	0,012	0,002	0,001	0,008

Notes: The FHW value for the timeframe 2004-2012 can be seen from the mean statistic. In addition to total FHW value, the standard deviation of the FHW measure is given.

Source: Author's calculations

The negative binomial regression models for age, where the dependent variable is the number of transactions and the independent variables were the age groups of buyers and sellers was statistically significant in both datasets ($p < 0,000$). The results of the model can be seen in Table 8, from which we can see that the rate of transactions is statistically significantly lower in the first age group where the participants are younger than 26 years old, since all the IRR values are above 1 and the youngest age group is the base value.

Table 8. Negative binomial regression model for the number of transactions in time by age group

Independent variables	Dataset 1		Dataset2	
	IRR	z-value	IRR	z-value
Base value-Buyer is less than 26 years old				
Buyer's age is 26-35	2,177*	13,52	1,933*	14,01
Buyer's age is 36-45	1,315*	4,71	1,078	1,55
Buyer's age is 46-55	2,586	1,62	0,913	-1,89
Buyer is older than 55	1,176*	2,76	0,891*	-2,36
Buyer's age not determined	3,056*	18,71	-	-
Base value-Seller is less than 26 years old				
Seller's age is 26-35	6,626*	29,11	6,398*	35,55
Seller's age is 36-45	6,141*	27,91	5,954*	34,06
Seller's age is 46-55	5,818*	27,06	5,585*	32,83
Seller is older than 55	14,895*	41,61	15,753*	53,02
Seller's age not determined	14,820*	45,19	0,161	-1,69
Constant	5,960*	29,10	6,980*	37,99

⁸ We use Kruskal-Wallis rank test which indicates that at least one groups mean ranks in a dataset are statistically significantly different from another's. Conducting a Dunn's test on the data shows that in Dataset1 the only pairs of age groups that do not differ significantly in mean ranks are groups 36-45 and 46-55, and 25-35 and ≥ 56 . In Dataset2 the Dunn's test shows significant differences in mean ranks in all pairs of age-groups except between age groups 36-45 and 46-55.

Notes: Incident rate ratio (IRR) and z-values from negative binomial regression for the number of transactions (dependent variable) in Dataset1 and Dataset2 by age group. Transactions were aggregated by quarter year, buyer's age group and seller's age group. The independent variables are given in the first column. The * denotes values that are statistically significant at the 5% level. Source: Author's calculations

When looking at the yearly average FHW statistics in both datasets (see example of Dataset1 in Figure 9) it can be seen that the herding measure in the lowest age group (buyer's age is less or equal to 25) increased slightly in 2008. Age groups 36-45 and 46-55 show little to no variation across years in both datasets.

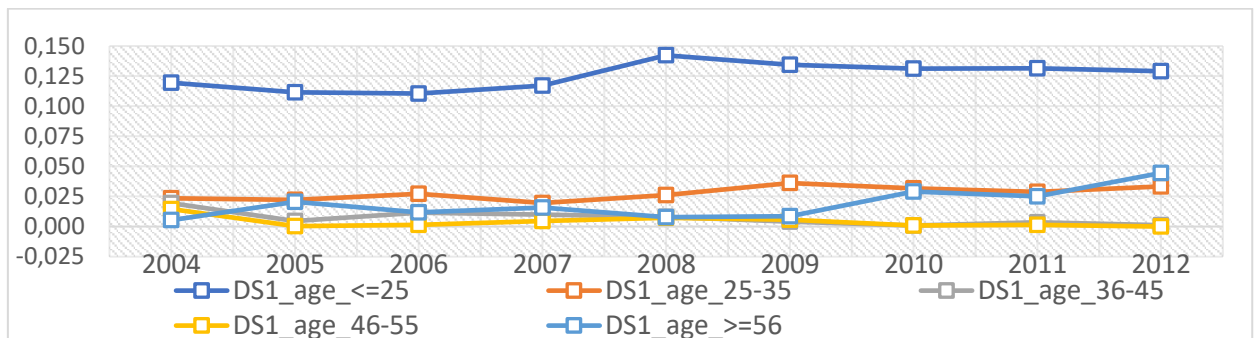


Figure 9. Yearly average FHW measure for different age groups in Dataset1.

Notes: The figure displays the yearly average FHW statistic values and indicate the strength of herding in a particular year.

Source: Author's calculations

The FHW measures relative to the level and type of education can be seen in Table 10. The FHW measure for investors with no university degree in Dataset1 is 0,044, for buyers with a bachelors' degrees the statistic is 0,039 and for buyers with a masters' degree or higher the statistic is 0,046⁹. The herding measures for Dataset2 are lower than the same measures in Dataset1 but showed that people with no university degree herd more than people with a university degree¹⁰. The FHW measure for buyers with an economics related education in Dataset1 is 0,033, for buyers with an IT related education the statistic is 0,074 and for buyers with a degree that is not related to economics, IT or real science the statistic is 0,042. Compared to Dataset1 the herding measures are smaller in Dataset2 and the investor group with a economics related education showed lower levels of herding than IT or real science educated investors in both datasets¹¹.

⁹ When testing for the significant difference between highest obtained degree groups it was found that in Dataset1 there was no statistically significantly different group.

¹⁰ After the statistically significant result of a Kruskal-Wallis rank test the Dunn's test in Dataset2 shows that the mean ranks of FHW statistics from the group with no university degree differ significantly from the other highest degree groups.

¹¹ The Dunn's test showed that there was no one type of education group that was statistically significantly different from all other groups.

Table 10. Summary of FHW values related to level and type of education

Dataset	Statistic	Highest obtained degree			Type of education			
		No degree	Bachelors' degree	Masters' degree	Econometrics	IT	Real science*	Other
Dataset1	Mean	0,044	0,039	0,046	0,033	0,074	0,097	0,042
	Std.Dev	0,013	0,013	0,018	0,015	0,038	0,115	0,013
Dataset2	Mean	0,039	0,027	0,024	0,017	0,061	0,100	0,028
	Std.Dev	0,011	0,011	0,019	0,014	0,045	0,134	0,011

Notes: * the relatively high value for the FHW statistic is due to the small number of observations for this category. The FHW value for the education related variable group can be seen from the mean statistic. In addition to total FHW value, the standard deviation of the FHW measure is given. Source: Author's calculations

The yearly average FHW measures for highest level of degrees is shown in figure 11. A significant rise in the FHW measure can be seen in both datasets from 2007 to 2009 for buyers who had a master's degree or higher. Overall the herding measures for both datasets have remained relatively low in all education categories related to the highest obtained degree.

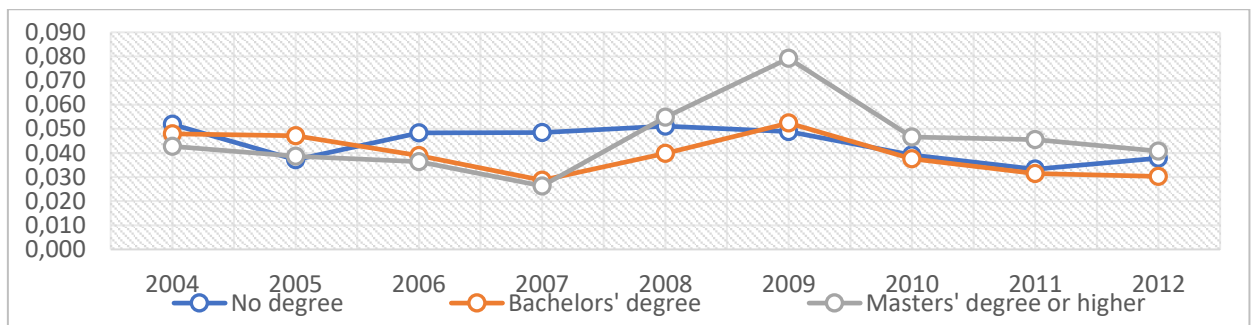


Figure 11. Yearly average FHW measure for different highest levels of degrees in Dataset1. Notes: The figure displays the yearly average FHW statistic values and indicate the strength of herding in a particular year. Source: Author's calculations

The yearly average FHW measures for different types of degrees is shown in figure 12. The first thing that can be seen is a very high FHW value for real science degree owners in Dataset2, which is due to the low number of transactions that was used to calculate the statistic in that year (see table 12). A slight jump of the FHW statistic can be seen from 2008 to 2009 in the group who owned a degree in an IT related field.

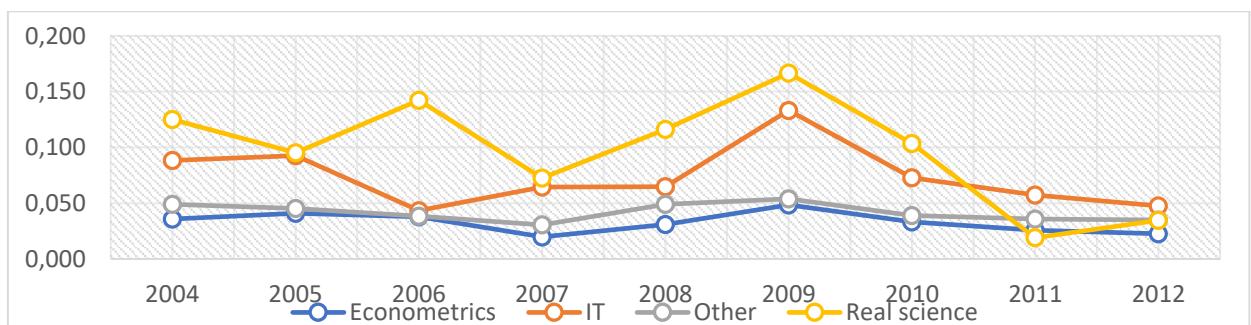


Figure 12. Yearly average FHW measure for different types of degrees in Dataset1.

Notes: The figure displays the yearly average FHW statistic values and indicate the strength of herding in a particular year.

Source: Author's calculations

The FHW measures for subject grade quartiles are given in table 13 where a slight increase can be seen in all subject and dataset when the grade quartile increases from one to four¹². Taking into account the specifics seen in the descriptive statistics section of this article of the subject grade quartile data it can be concluded that the FWH values are biased to a degree due to missing values on the sell side.

Table 13. FHW statistics for subject grade quartiles in Dataset1 and Dataset2.

Subject	Dataset	Grade quartile			
		Q1	Q2	Q3	Q4
Math grade quartile	Dataset1	0,069 (0,038)	0,089 (0,036)	0,101 (0,035)	0,116 (0,032)
	Dataset2	0,055 (0,038)	0,076 (0,041)	0,085 (0,041)	0,097 (0,039)
Native language grade quartile	Dataset1	0,054 (0,030)	0,062 (0,037)	0,064 (0,034)	0,080 (0,041)
	Dataset2	0,039 (0,028)	0,046 (0,040)	0,049 (0,029)	0,060 (0,035)
English language grade quartile	Dataset1	0,081 (0,023)	0,085 (0,034)	0,090 (0,026)	0,097 (0,032)
	Dataset2	0,069 (0,027)	0,075 (0,033)	0,070 (0,029)	0,081 (0,034)

Notes: The FHW measures for different subject grade quartiles. The Q is the grade quartile, Q1 being the lowest and Q4 the highest. The FHW statistic's standard deviation is given in the brackets.

Source: Author's calculations

For further analysis we constructed logistic regression models for each subject where the dependant variable was the buyer having a grade in the highest quartile versus having a grade in the lowest quartile of the subject and the independent variables were the number of transactions by buyers and sellers who had either the lowest or highest grade in the same subject and quarter. The results for the three analysed subjects were very similar. The odds ratio of the buyer having a high grade (versus a low grade) was not influenced by the amount of transactions by sellers with either a low or a high grade. The odds ratios relative to the statistically significant independent variables were 0,99 for the number of buy transactions by investors with the lowest quartile grade and 1,01 for the number of transactions by investors with the highest quartile grade. The model translates to a maximum of a 5% increase or decrease for 15 additional transactions in a quarter (keeping other variables at their mean values) in the probability of a buyer with a highest quartile grade making a transaction.

¹² A one-way ANOVA and additional Tukey tests show that the lowest and highest quartile FHW scores are statistically statistically different in maths in both datasets and in native language in Dataset1

The yearly average FHW measures for different subject grade quartiles in Dataset1 are given in the next three figures (figures 14-16). When comparing the three figures it can be seen that a significant decrease in the yearly average FHW measure can be seen in the native language variable group as well as the math group but not amongst the English language group.

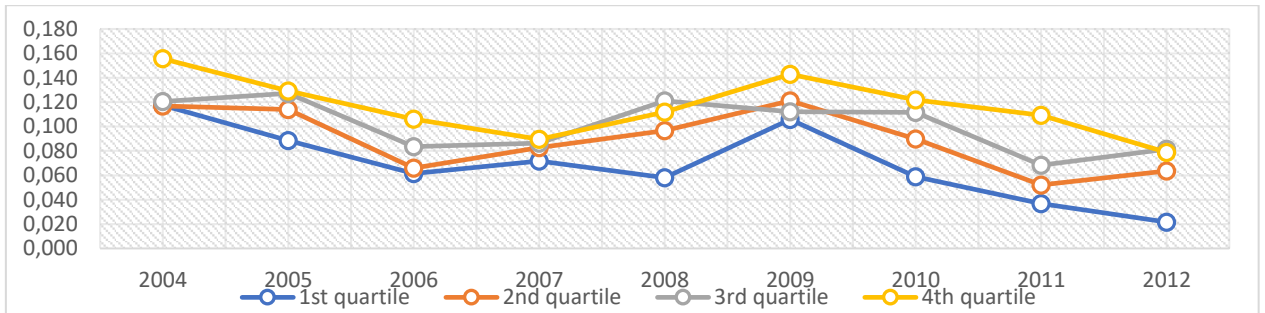


Figure 14. Yearly average FHW measure for math grade quartiles in Dataset1.

Notes: The figure displays the yearly average FHW statistic values and indicate the strength of herding in a particular year. The theoretical maximum value for the FHW measure in this article is 0,25.

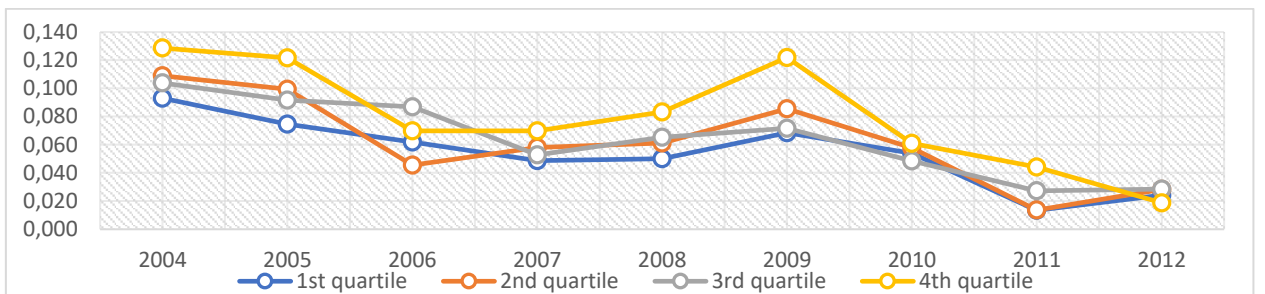


Figure 15. Yearly average FHW measure for native language grade quartiles in Dataset1.

Notes: The figure displays the yearly average FHW statistic values and indicate the strength of herding in a particular year. The theoretical maximum value for the FHW measure in this article is 0,25.

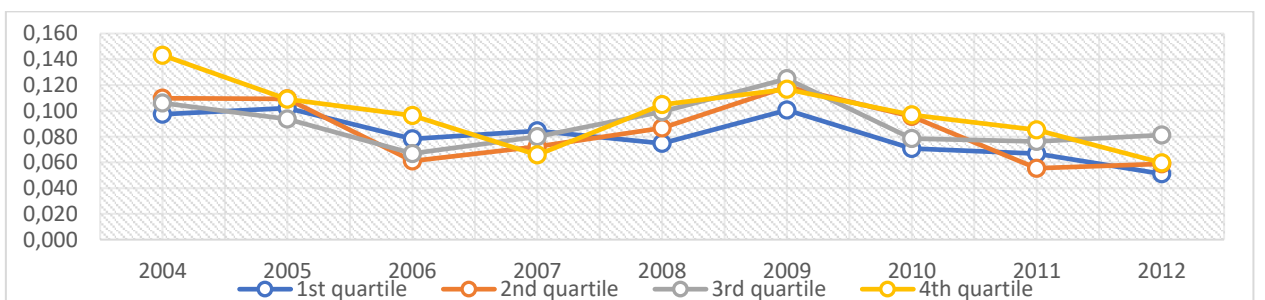


Figure 16. Yearly average FHW measure for English language grade quartiles in Dataset1.

Notes: The figure displays the yearly average FHW statistic values and indicate the strength of herding in a particular year. The theoretical maximum value for the FHW measure in this article is 0,25.

5. Discussion

Since previous literature is quite sparse we turn toward previous findings in psychology and herding in other markets to compare our findings.

It is important to keep in mind that real estate related data is extremely specific. In the context of this article the subjects analysed were people who entered into a real estate transaction by themselves. Quite interestingly the data showed that in both datasets women made more transactions than men. Contradictory to findings in literature that women may tend to herd more than men, the FHW statistic does not show a tendency towards herding in either genders or datasets due to its value approaching almost zero. However, when we look at the yearly average FHW statistic for gender then it can be seen that in Dataset1, which includes new developments and multiple parties on either side of the transaction, the statistic has considerably decreased in time. This decrease of herding in time partially follows Chang and Lin (2015) findings regarding masculinity and herding, which found that lower herding is linked to lower masculinity in culture.

The FHW statistic in age groups indicates moderate herding in the lowest age group, which is the group where the buyers and sellers are 25 years old or younger. Low but similar herding measures are found in age groups 25-35 and over 55; and non-existent herding in the age groups 36-45 and 46-55. One could argue that the absence of herding in the age group 36-55 is due to the investors financial independence and emotional stability at that time in ones life. Bhandari and Deaves (2006) show that people close to retirement tend to be more overconfident and overconfidence has in turn been linked to leading to higher herding tendencies by Chang and Lin (2015) which may be why one of the groups where herding behavior was detected was the oldest group.

We also look at the highest obtained education. Previous research on the matter of herding and it's connection to the investors education or sophistication shows that herding behavior tends to emerge more amongst the less sophisticated (Chang and Lin, 2015; Bhandari and Deaves, 2006; Merli and Roger, 2013). The FHW statistics based on our data shows rather low herding values for all groups. Interestingly the FHW values are statistically significantly different for the no university degree group in the dataset that included only transactions between two non-commercial parties.

Following that we analysed the type of education that the buyer or seller had which showed that the FHW measure for people who had an economics related education was considerably lower than that of people who had an IT or real science related degree in both datasets. In addition when looking at the herding measures in time it can be seen that almost all groups the herding measure increased from 2008 to 2009. Which in turn follows the same logic of increased herding in times of market stress that Vassilios et.al (2015) showed in the US REIT's sectors in 2004-2013.

Based on the FHW measure of the groups by the subject grade quartiles, we can see a slight increase in all subjects when the grade quartile increases from lowest to highest. Taking into account the specifics seen in the descriptive statistics section of this article of the subject grade quartile data it can be concluded that the FWH values are biased to a degree due to missing values on the sell side so it would be incorrect to assume a herding of that measure to actually occur. The additional analysis on the transactions and investors relative to the grade quartile data showed the probability of an investor having a high quartile grade was influenced by the number of buy transactions in the same quarter that were made by both investors with a high and a low quartile grade but the number of transactions made by those investors does not change enough in time to indicate herding.

6. Conclusion

The aim of the article is to shed light on the concept of herding in the real estate market and to show how factors such as gender, age and education affect herding in the real estate market. The latter was done using unique datasets that enables access to data related to detailed real estate transactions and investor specific educational variables including the level and type of education and the high school final exam grade quartiles.

To conclude the FHW method indicates no gender based herding in real estate transactions which is also backed by findings via alternative methods. However the FHW method does indicate moderate herding amongst people that are under 26 years old and low to moderate herding amongst people who are older than 55. The absence of a university degree leads to higher herding only in transactions between two non-commercial parties. Individuals with economics degree show lower levels of herding than people with IT or real science related degrees. The results on the effects of subject grade quartiles on herding are inconclusive.

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KOKKUVÕTE

KUIDAS MÕJUTAVAD SUGU, VANUS JA HARIDUS KARJAKÄITUMIST KINNISVARATURUL?

Anne-Liis Tänav

Lähiminevikus on majandusteadlaste fookus nihkunud traditsiooniliselt rahanduselt, mis keskendub ratsionaalsele inimesele, tõhusatele turgudele ja kasulikkuse maksimeerimisele, üle käitumusliku rahanduse suunas. Inimesed ja nende käitumine ning sellega seotud otsustusprotsessid on keerulised ja just nende tõlgendamisel tuleb abiks käitumuslik rahandus, mis võimaldab suunata tähelepanu tavapäraselt “Miks?” küsimuselt, küsimusele “Kuidas”.

Käesoleva töö eesmärk on uurida karjaitumise nähtust ja selle seost kinnisvaraturuga analüüsides selle eesmärgi valguses karjakäitumise ilmnemist demograafiliste ja hariduslikku tasuta määravate tunnuste alusel eesti kinnisvaraturul. Kuna olemasoleva kirjanduse hulk karjakäitumise teemal kinnisvaraturu osas on kesine, siis põhineb käesolevas töös analüüsitud kirjandus karjakäitumisest valdavalt aktsiaturgudel läbiviidud uuringutel ja teemaga seotud psühholoogia kirjandusel.

Töö aluseks olevad uurimusküsimused, mis kujunesid töö aluseks olevate andmete põhjal on:

- Kas Tallinna kinnisvaratehingute põhjal ilmneb sool põhinev karjakäitumine?
- Kas erinevate vanuserühmade inimesed näitavad Eesti kinnisvaraturul karjakäitumist?
- Kas kõrgeim omandatud hariduse tase on tegur, mis võib näidata karjakäitumise esinemist Eesti kinnisvaraturul?
- Kas omandatud hariduse tüüp võib mõjutada karjakäitumist Eesti kinnisvaraturul?
- Kuidas mõjutavad teatud õppeainete põhiteadmised kalduvust karjakäitumisele kinnisvara ostmisel hilisemas elus?

Olemasolev kirjandus ei ole keskendunud karjakäitumise nähtusele kinnisvaraturul ja otsib endiselt selle võimalikke algpõhjuseid, olles tänaseni tõestanud kõige enam seoseid karjakäitumise

ja soo ning harituse vahel. Võttes arvesse teisi turge käsitlevaid võimalikke järeldusi, näeme, et on olemas suur hulk sisemisi (sugu, vanus, haridus, haritus) ja välised (teised turuosalised) karjakäitumise tekkimist põhjustavaid tegureid, mis võivad esineda ka kinnisvaraturul. Lisaks eelnevale on mitmed atiklid välja toonud seose karjakäitumise ja majanduskriisi vahel. Eelneva seoses puhul on osadel juhtudel mainitud karjakäitumist kui majanduskriisi põhjust, teistel juhtudel kerkib karjakäitumine reaktsioonina majanduskriisile.

Töös seatud uurimisküsimustele vastamiseks analüüsiti Tallinna, Eesti pealinna, anonümiseeritud kinnisvaratehingute andmeid aastatelt 2004-2012, mis sisaldasid teavet ka ostjate ja müüjate soo, vanuse ja haridusliku tausta kohta. Hariduse kohta on uuritavateks tunnusteks isiku kõrgeim omandatud haridustase (pole ülikooli kraadi, bakalaureusekraad, magistrikraad või kõrgem), hariduse liik (majandus, infotehnoloogia, reaalteadus, muu) ja kooli õppeainete (matemaatika, inglise keel, emakeel) lõpueksami hinde kvartiilid (1-4). Kinnisvaratehingute andmed pärinevad riiklikust kinnistusraamatust ja haridusega seotud andmed Haridus-ja Teadusministeeriumilt.

Peamiseks analüüsimeetodiks käesolevas töös oli FHW meetod, mille abil leiti karjakäitumise tugevus valimis. Karjakäitumise võimalikku esinemist kontrolliti lisaks FHW meetodile ka erinevate alternatiivsete meetoditega, mis autori arvamusel võiks sobituda üldise karjakäitumise ilmnemise definitsiooniga. FHW meetod on üks põhilisematest meetodist, millega on varasemas kirjanduses hinnatud karjakäitumise olemasolu. Nimetatud meetod põhineb loogikal, mille kohaselt esineb karjakäitumine juhul, kui teatud perioodis on ühel tehingu poolel (ost/müük) rohkem aktiivsust.

Karjakäitumise ilmnemise kontrolli jaoks koostati analüüsi aluseks kaks andmestikku, millest esimene koosnes kinnisvaratehingutest kus vähemalt ühel tehingu poolel (ost või müük) oli ainult üks füüsiline isik. Teine andmestik oli esimese kitsendus ja koosnes vaid tehingutest, mis olid tehtud kahe füüsilise isiku vahel.

Analüüsi tulemuste kohaselt ei näita FHW meetod, et kinnisvara tehingutes esineks soost tingitud karjakäitumist, mis annab vastuse meie esimesele uurimisküsimusele. Erinevalt soost näitab FHW meetod mõõdukat karjakäitumist alla 26-aastaste inimeste seas, mis on statistiliselt oluliselt kõrgem mõlemas käesoleva artikli jaoks koostatud andmestikus ja täiendavalt ka madala või mõõduka tugevusega karjakäitumise ilmnemist üle 55-aastaste inimeste seas. Karjakäitumise ilmnemine välistes vanusegruppides võib olla seotud nendes vanusegruppides olevate investorite

suurema mõjutatavusega ja võimekusega tehingut sooritada. Kahjuks puudus töö raames analüüsiks info isikute majandusliku tausta kohta, mis oleks aidanud teatud investorite gruppide karjakäitumise põhjuseid paremini seletada.

Haridusliku tausta ja karjakäitumise esinemise analüüsi tulemusena selgus, et ülikoolikraadi puudumine toob kaasa suurema tugevusega karjakäitumise ainult kahe füüsilisest isikust osapoole vahelistes tehingutes. Majanduse taustaga investorid näitavad madalamat karjakäitumise määra võrreldes infotehnoloogia ja reaalteaduste taustaga investoritega. Antud tulemused on kooskõlas varasemalt leitud tulemustega, mille kohaselt haritud investorid näitavad väiksemat karjakäitumist.

Tulemused, mis puudutavad keskkooli lõpueksami hinnete kvartiilide mõju karjakäitumisele, ei ole ühesed. FHW meetod näitab madala tugevusega karjakäitumise esinemist, mis on suurem kõrgema hindega investorite grupi puhul võrreldes madalaima hindega investorite gruppi, kuid võttes arvesse eksami hinnete andmete tausta, siis on FHW meetod kallutatud kõrgema karjakäitumise määra poole, kuna müügi poolel on enam puuduvaid andmeid.

Edasisteks uuringuteks võiks andmestikku laiendada kaasates nii investeringuga seotud rahalisi väärtusi kui ka tunnuseid, mis aitaksid kirjeldada investorite võimekust tehingut sooritada. Eelnevate andmete olemasolu aitaks paremini selgitada käesoleva töö raames saadud tulemusi ning võimaldaks rakendada ka teisi karjakäitumise tuvastamiseks väljatöötatud meetodeid.