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Exploring Lithuanian Real Estate Crowdfunding Investors' Rationality

The research aims to assess how rational investors are in making real estate crowdfunding investment decisions and weather similar rationality investors share common individual-level characteristics. The research data was collected through an online survey and investors' rationality was assessed according to risk & return and behavioral biases criteria. Results revealed that 18% of the respondents were rational and as much as 78.1% of them demonstrated bounded rationality behavior. Further clustering of bounded rationality investors identified three distinct clusters and suggested that bounded rationality proved to be largely based on established behavioral biases rather than on failing to understand and apply risk and return criteria. In terms of individual-level characteristics, rationality of real estate crowdfunding investors significantly related to their financial knowledge, but not to their age, sex, income level, education, occupation, residence and interface with finance sector.

Keywords: crowdfunding, investor behavior, investor rationality; bounded rationality.

Tyrimo metu buvo siekiama įvertinti, kiek racionalūs yra investuotojai, priimdami sprendimus investuoti į NT sutelktinio finansavimo platformas, taip pat ar panašaus racionalumo investuotojai pasižymi panašiomis individualiomis charakteristikomis. Tyrimo duomenys buvo surinkti internetinės apklausos būdu, o investuotojo ribotas racionalumas buvo vertinamas pagal rizikos ir grąžos bei elgesio šališkumo kriterijus. Rezultatai atskleidė, kad 18 proc. NT sutelktinio finansavimo investuotojų buvo racionalūs ir net 78,1 proc. demonstravo riboto racionalumo elgseną. Tolesnės riboto racionalumo investuotojų analizės metu jie suskirstyti į tris klasterius, kurie atskleidė, kad ribotas racionalumas daugiausia buvo pagrįstas nustatytais elgsenos šališkumais, o ne nesugebėjimu suprasti ir taikyti rizikos ir grąžos kriterijus. Analizuojant individualaus lygio charakteristikas nustatyta, kad sutelktinio NT investuotojų racionalumas yra reikšmingai susijęs su jų finansinėmis žiniomis, bet ne su jų amžiumi, lytimi, pajamų lygiu, išsilavinimu, profesija, gyvenamąja vieta ar sąsaja su finansų sektoriumi.

Raktiniai žodžiai: sutelktinis finansavimas, investuotojų elgsena, investuotojų racionalumas, ribotas racionalumas.

Introduction

The rationality of investor behavior is a continuously important issue as it helps to understand not only how individual-level investment decisions are made, but also what and why the overall financial market's reaction is. The concept of investor rationality is a complex pheno-menon which could be addressed from the market or individual investors' perspective. In our research, we take an individual investor's approach and build on the neoclassical economic theory of utility maximization in investment decision making. In line with this theory, rational investment decisions are made taking into consideration risk

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and return tradeoff, include all available information and the investor's decision making is not biased. Yet, several researchers (Alimi, 2013; Gourinchas and Parker, 2002; Lunfang et al., 2018, Thaler, 2016) criticize or reject assumptions of neoclassical theories arguing that they are not realistic and fail to explain contemporary investors' behavior. Therefore, in line with the behavioral finance literature (Tuyon and Ahmad, 2018, Kumar and Goyal, 2016, Lin, 2011), in this research we support the view that there is no perfect rationality in the real word and investors are biased while making investment decisions. We build our research on the bounded rationality model, suggesting that investors don't have complete recourses for decision making, they face limitations of information, time, cognitive abilities; do not necessarily seek to maximize their utility, rather they accept alternatives that are good enough and satisfy rather than maximize their needs. Therefore, we expect that in our research majority of investors will demonstrate bounded rationality behavior as they will either deviate from risk and return criteria or demonstrate one or more cases of being biased.

Over the last decades globalization, technological innovations and digitalization, easier cross border investments and other factors have reshaped the investment environment and prompted the development of innovative financial products and services, such as real estate crowdfunding. Increased crowdfunding has enabled individuals and businesses to raise funds to finance projects and close the financial gap. In addition, crowdfunding offers investors the opportunity to invest in individual and business projects with no substantial savings and more opportunities to diversify investments. In this paper, we focus on the investment side of crowdfunding and question the behavior of an indivi-dual investor.

Innovative financial products, such as real estate crowdfunding, differ from the traditional ones in such characteristics as the lower amount of minimum investment, easier access, digital solutions, higher investment risk, lower level of regulation of the products and services and their providers, etc. All those characteristics enable investors to make quicker and more frequent investment decisions, yet leave them more vulnerable to overreaction, overconfidence, neglect of failure and other behavioral biases. According to J. H. Block et al. (2018) investors in innovative financial products also differ from traditional ones. Due to lower amount of minimum investment, the need for rapid investment decision making, investors in innovative financial products, such as real estate crowdfunding, are less equipped to perform detailed investment analysis than traditional ones (Buttice and Vismara, 2021) and more inclined to deviate from the perfect rationality. Diffe-rences in investor rationality can occur not only due to the changing financial system, but also to demographic characteristics. In terms of demographic characteristics, the results of previous research are mixed. Some research figured out that women are more rational investors than men (Kumar and Goyal, 2016; Lin, 2011; Prasad et al., 2021), while other research (Yuliawati et al., 2020) did not find a significant difference between gender and investor rationality. Also, previous research investigates

the difference of investor rationality between age (Charles and Kasilingam, 2013; Gonzalez-Igual et al., 2021; Kumar and Goyal, 2016; Talpsepp, 2013), income (Isidore and Christie, 2019; Kumar and Goyal, 2016), education (Gonzalez-Igual et al., 2021).

Interest in crowdfunding in the scientific literature is growing rapidly. Research works focuses on dynamics of crowdfunding (Harris and Wonglimpiyarat, 2020; Kim et al., 2020), factors affecting success of crowdfunding campaign (Liu et al., 2022; Xie et al., 2019), investor behavior in crowdfunding (Lukkarinen, 2020; Wallmeroth, 2019). However, there is a lack of research that aims to identify the rationality of such investors (Nitani et al., 2019) or to explore the individual-level characteristics of such investors. Demographic profile of investors was to some extent analyzed in regard to traditional and innovative financial products (Chen et al., 2019; Herve et al., 2019) and revealed that i.e. equity (Ke, 2021) and crowdfunding investments (Chen et al., 2019; Wallme-roth, 2019) are dominated by men, as women are more risk-averse than men (Gonzalez-Igual et al., 2021). Moreover, M. Gonzalez-Iqual et al. (2021) also found that women and older investors are less impact of behavioral biases due to higher education level.

The aims of this research are two-fold. Firstly, we aim to assess how rational investors are in making real estate crowdfunding investment decisions. Secondly, we explore if investors with a similar rationality level share common individual-level characteristics.

The research methods applied in this paper are: logical comparative analysis of scientific literature, questionnaire survey, descriptive analysis; and clustering analysis.

The concept and types of investor rationality

Theoretical background. Investment related rationality is analysed from two perspectives – market rationality (more often referred to as market efficiency) and individual investor rationality, which is the object of this paper. According to the classical paradigm of financial theory, investors are considered as rational investment decision makers who seek to maximize their utility. Therefore, rationality is based on the concept that investor act rational and deliberate all available information before making investment decisions, while the capital markets are efficient and asset prices reflect all available information (Mushinada and Veluri, 2018). According to classical economic literature, perfect, rational investor is described as *homo economicus*. Homo economicus has complete information that influence his investment alternatives and decision and always succeed to maximize his indeed benefit with unlimited cognitive resources (Fromlet, 2001). Moreover, homo economicus learns rapidly, even if after making a single mistake, he makes conclusions to avoid errors in the future (Thaler, 2000). Seems that classical economic theories neglect the learning process and consider that investor deal with a problem rapidly and from the first attempt. Investment rationality is among the key assumptions of several finance theories such as Neumann-Morgenstern Expected Utility Hypothesis (1944), Markowitz Portfolio Theory (1952),

Modigliani and Brumberg Life Cycle Hypothesis (1954), Friedman Permanent Income Hypothesis (1957) and Fama Efficient Market Hypothesis (1991). The main assumptions of these theories are that investors are rational, also, they have access to all relevant information and use it for the decision making and seek to maximize their utility while the capital markets are efficient. Yet, several researchers (Alimi, 2013; Gourinchas and Parker, 2002; Lunfang et al., 2018, Thaler, 2016) criticize or reject assumptions of neoclassical theories arguing that they are not realistic and fail to explain contemporary investors' behavior. Based on H. A. Simon (1955), who was the first to doubt homo economicus and neoclassical assumptions, perfect optimization is not possible in the real word as it demands for complete information for the decision making and complex decision-making procedures. Homo economicus was also criticized for concentrating only on logical consistency, but not for social rationality (Wang, 2001). The concept of bounded rationality (introduced by Simon) takes a position that investors tend to behave in an objectively rational way, but being unable of doing so, satisfy themselves with the rationality of the decision-making procedures used. Therefore, bounded rationality is a concept used to describe the rational choice that takes into account limitations of investors both cognitive and knowledge (Simon, 1997). Bounded rationality is neither maximization nor irrationality. It is about optimization under constraints, such as imperfect information, limitation of cognitive abilities, knowledge, time constraint, so bounded rationality is understood as constrained maximization. Nature of bounded rationality is a consequence of a complex environment or limitations of investor's cognitive abilities, time constraint (Lee, 2011). Bounded rationality theory shifts accents from classical homo economicus man, who has complete information and demonstrate characteristics of utility maximization to acknowledge limited knowledge and satisfying behavior. The concept of bounded rationality does not reject the theory of rationality, but only indicate the bounds of rational choice. Bounded rationality is not the same as irrationality, because investors make every effort to make as rational investment decision as possible under constraints. Even bounded rationality is not understood as irrationality, but the main principles of bounded rationality lie at the foundation of behavioral finance. The theoretical foundations of behavioral finance come from the bounded rationality theory of H. A. Simon (1955) and prospect theory of D. Kahneman and A. Tversky (1979). Behavioral finance suggests an alternative paradigm that does not assume pure rationality of investors and pure efficiency of financial markets (Tuyon and Ahmad, 2018). Theory of behavioral finance tries to understand and explain why investor are not pure rationality and shift from neoclassical assumptions of rationality. At the center of the behavioral finance are the irrationality of investors and factors that influence it. The irrationality of investors is determined by various factors, such as emotions, psychological (Kahneman, 2003), social or even biological factors (Ellis, 1976). Various research showed that psychological and social factors are important determinants of behavior of

investor who do not consistently behave as pure rational decision makers. Due to psychological, social or other factors investors demonstrate systematic biases in investment decisions making to simplify their investment decisions. Behavioral biases and heuristics are understandable as mental shortcuts of investment decision making and according to D. Kahneman and A. Tversky (1974) "are quite useful, but sometimes they lead to severe and systematic errors". The need for decision-making heuristics and behavioral biases arises from the complexity of the decision-making task and possibility to make a fast investment decision in an uncertain environment (Julmi, 2019).

Types of investors rationality. Scientific literature distinguishes three types of rationality of investor behavior – rational behavior, bounded rationality behavior and irrational behavior (Tseng, 2006). Each type of rationality is based on different theories and assumptions, which are summarized in Table 1.

According to main assumptions of investor rationality, pure rationality and irrationality are understood as opposing ends of investor behavior and bounded rationality is somewhere between pure rationality and irrationality. An investor with bounded rationality behavior make investment decisions based both on rational criteria, such as investment risk and return, and irrational criteria, such as behavioral biases.

Measures of the investor rationality. The literature review revealed the ambiguity not only of the concept of investor rationality, but also of the limits in the criteria to identify its type or measure its level. Under the rational investment decision model, investors are pure, perfectly rational and have complete information necessary to make investment decisions. According to works of E. J. Elton et al. (2011) and M. Nitani et al. (2019) main determinants of rational choice are related to return and risk of specific investment decision. Also,

Table 1. **Main assumptions of three types of investor rationality**

Assumptions	Rational behavior	Bounded rationality behavior	Irrational behavior
The rationality of investor	Pure, perfect rationality	Bounded rationality	Irrationality
Availability of information	Complete	Limited	Limited
The process of decision making	Systematic, step by step, logical	Complex, interconnected steps, but not necessarily step by step	Complex, involving mental shortcuts
Main objective	Utility maximization	Utility maximization not always the main goal, often sufficient satisfaction	Needs satisfaction
Main determinants	Utility criteria (return and risk), full information	Utility criteria, limited information, behavioral biases	Emotions, social, psychological factor, heuristics and behavioral biases

one of the main objectives of the rational investment decision is to maximize investors utility. Rational investors make investment decisions based on logic and systematically evaluating decision-making procedures (Robbins, 2002). Rational decision-making procedures frequently used by researchers (i.e., Kumar and Goyal, 2016; Lin, 2011; Cohen and Kudryavtsev, 2012; Nitani et al., 2019) are based on three-stage model of rationality in decision-making proposed by H. Mintzberg et al. (1976). Such investment decision-making procedures commonly involve (1) search for all possible alternative investments, (2) analysis of the alternatives, (3) comparison and selection of one alternative. Although, researches use different assumptions and decision-making processes, yet use of available information, assessment of return and risk criteria and maximization of wealth are the key measures that characterize investors' rational behavior.

Despite fundamental foundations of investors rational behavior, in many cases findings of research show that investors are biased while making investment decisions (Kumar and Goyal, 2016; Lin, 2011) and that there is no perfect rationality in the real word. Bounded rationality model suggests that investors don't have complete recourses for decision making, they face limitations of information, time, cognitive abilities; they accept alternatives that are good enough, therefore satisfies rather than maximize. Based on behavioral theories, investors make decisions taking into account environmental perceptions, behavioral and psychological factors, limited cognitive abilities, and demonstrate behavioral biases when making decisions. Behavioral biases are the key areas of interest in behavioral finance and serve as good proxy for measurement of irrational or bounded rationality investment behavior. Over the last year a large and quite diversified bulk of empirical research addresses behavioral biases in investment related to peer pressure (such as anchoring, herding behavior, collective conservatism), information effects (status quo bias, representativeness bias), priming effect (mental accounting; vividness).

Data and methodology

Research background. For this research, we have chosen a specific innovative investment product – real estate crowdfunding and surveyed existing investors of one of the leading Lithuanian real estate crowdfunding platforms. In our research, we aimed to assess how rational Lithuanian real estate crowdfunding investors are in making their investment decisions and what common investor level characteristics their share.

In our research, similar to V. N. C. Mushinada and V. S. S. Veluri (2018) we expect to be able to group real estate crowdfunding investors into 3 groups: 1) rational, 2) bounded rationality and 3) irrational investors. As presented in Table 2 to assess investors' behavior two groups of criteria were used – risk and return criteria and behavioral biases. The results of previous research are ambiguous; also they do not specifically cover real estate crowdfunding or Lithuanian background. While S. Agarwal and B. Mazumder (2013), H. Hong et al. (2004),

Table 2. **Criteria for the evaluation of investor rationality**

Return and risk criteria (N=9)	Behavioral biases (N=5)
If while making real estate crowdfunding decision an investor evaluates	*If while making real estate crowdfunding decision an investor demonstrates*
Annual interest rate	Herding bias (Lin, 2011; Shusha, Touny, 2016)
Return and risk trade-off	Status quo bias (Kipsaat, Olweny, 2020; Li et al., 2019)
General real estate project risk class (A, B, C, D)	Familiarity bias (Linciano and Soccorso, 2012)
Information related to the riskiness of the platform (regulation, project appraisal procedures, etc.)	Information novelty bias (Kartašova, 2012)
Type of mortgaged real estate and related information and risks	Overconfidence bias (Lin, 2011; Sahai, 2015; Shusha, Touny, 2016)
Real and projected LTV ratio	
Risk of financial default	
Risk of economic situation	
Market risk	

A. Lefevre and M. Chapman (2017) identified bounded rationality behavior of investors, G. Cohen and A. Kudryavtsev (2012), M. Nitani et al. (2019) advocated for the rationality of investors' actions. Given that the subject of our study is real estate crowdfunding (less regulated innovative financial products with easier access and lower investment amounts), we propose that when deciding which real estate crowdfunding objects to invest in, the majority of investors do not consider all available rational criteria and also demonstrate one or more behavioral biases. As a result, the majority of real estate crowdfunding investors demonstrate one or more behavioral biases.

In our research the risk and return criteria questions were compiled based on the main return and risk measures relevant to real estate crowdfunding (platform risk, credit risk, real estate project risk, default risk, market risk, economic situation risk). These return and risk criteria are easily adapted to other types of crowdfunding. To identify investor bounded rationality or irrational behavior we used five behavioral biases – herding, status quo, familiarity, information novelty biases, overconfidence. These behavioral biased were also selected because of the possibility of adapting them to a specific innovative financial service – real estate crowdfunding.

In our assessment, rational crowdfunding investment decisions are made taking into consideration risk and return criteria and their decision making is not biased. On the other hand, in this research, we expect that majority of real estate crowdfunding investors will demonstrate bounded rationality behavior as they will either deviate from risk and return criteria or demonstrate one or more instances of being biased. And, finally, those investors, who indicate being biased by all assesses indicators and who do not correctly identify any of the risk and return criteria will be treated as being irrational. Table 3 summarizes the

Table 3. **Assessment of investor rationality based on the demonstrated decision-making behavior**

Type of investor rationality	Scores of risk and return criteria	Scores of behavioral biases criteria
Rational investors	≥5 risk and return criteria	N = 0
Investors with bounded rationality	< 5 or ≥5 risk and return criteria	N = 1–4
Irrational investors	<5 risk and return criteria	= 5

criteria for assigning investors into rationality groups based on their demonstrated decision-making behavior.

Sample and data collection procedure. We collect data from real estate crowdfunding investors in Lithuania in the spring of 2021. In Lithuania, real estate crowdfunding has emerged quite recently, in 2018 and are growing exponentially. Comparing the data of 2021 September with the date of 2018 September, the real estate loan portfolio grew 39 times in one of the largest real estate crowdfunding platforms in Lithuania. It is important to note that Lithuania has an excellent climate for the provision and development of innovative financial products, such as real estate crowdfunding, which reveals why this country was chosen in this research. In Lithuania are the four main real estate crowdfunding platforms, however the exact number how many investors invest in real estate crowdfunding in Lithuania are not known, because some platforms are global and do not reveal statistic about Lithuanian investors. To conduct the research, we collaborated with one of the largest real estate crowdfunding platforms in Lithuania. The research questionnaires were sent directly to investors of that platform and were publicly distributed online. A total 128 data of real estate crowdfunding investors were collected during the survey. Given 2574 investors who invested in the platform during the period of our survey (Profitus[1], 22-07-2021) the amount of data is considered reliable and suitable for further analysis.

The survey questionnaire was constructed in 2 main parts and 25 questions. In the 1st part of the survey, 11 questions about 2 groups' individual-level characteristics of investors (financial knowledge and demographic characteristics) were asked. The investor level of financial knowledge is based on 4 questions, which are developed by the authors adapting the evaluation scale used in A. Lusardi et al. (2014) research. Another 7 questions were for demographic statistics, such as investors' age, gender, income, education, occupation status, residence and interface with the financial sector. The 2nd part of the survey was designed to evaluate investor rationality. In this part, a total of 14 questions were asked. Thus, 9 questions were about risk and return criteria and the remaining 5 questions measured five behavioral biases – herding, status quo, familiarity, information novelty biases, overconfidence. All questions in the second part were rated on the Likert scale ranging from 1-strongly disagree to 5-strongly

[1] Profitus. Review of the results of the first half of 2021. Internet access: < https://www.profitus.lt/naujienos/59>, [accessed March 28, 2022]

agree in order to be able to see not only if investors are rational but also how strong is their rationality. Behavioral biases questions were constructed based on previous research (Baker et al., 2019; Kipsaat and Olweny, 2020; Li et al., 2009; Lin, 2011), yet adapted to the real estate crowdfunding investments. Each of behavioral biases was identified by a single statement. Herding behavior was identified if the investor made crowdfunding investment decisions relying on opinions or decisions of family, friends, or other investors. Status quo effect was determined if the investor, after receiving the latest information about the better results of another crowdfunding platform, resisted the changes and did not modify his/her investment decisions. Familiarity bias was scored when an investment decision was based on familiar criteria (language, the platform operating in the home country). Information novelty bias was identified if the investor made a decision based only on the latest information about the platform, the specific real estate project, and not analyze all possible information. Overconfidence is the last behavioral biases that assessed in this research. Investors were considered as overconfident if they associate good results only with their abilities while failing with the market situation.

Data analysis methods. The data analysis involved methods, such as descriptive statistics, chi-Square test, clustering. Before analyzing the data, the reliability of collected data was performed using Cronbach's alpha. Cronbach's alpha was used to measure the reliability of the questionnaire. Factors with a Cronbach's alpha above 0.7 were considered as a reliable and acceptable index (Aiken, 2001).

An investor was considered as being rational if he did not demonstrate any behavioral bias and made a crowdfunding investment decision based on at least 5 return and risk criteria (out of 9). If an investor demonstrated at least one behavioral bias, he was considered as being bounded rationality. If an investor demonstrated all 5 behavioral biases and evaluated less than 5 return and risk criteria, he was considered as an irrational crowdfunding investor. Because we expected most investors will demonstrate bounded rationality behavior, we employed Hierarchical Cluster analysis (HC) that is typically used to explore similarity between observations. We used Ward's clustering method that finds clusters with tight minimum variance. Ward's minimum variance method calculates the distance between cluster members and the centroid. In the centroid of cluster is minimized the sum of squared Euclidean distances between the centroid point and each other point in the cluster (Strauss & Maltitz, 2017). Chi-Square test was performed to investigate whether there were significant differences between individual-level characteristics of investors and their rationality. Chi-Square test was selected due to possibility compare categorical variables.

Research limitations. The main limitations of the study are related to the sample size of the study and the number of rationality criteria. In this research, we investigate two groups of rationality criteria and in the future research, we could include an additional group of rationality criteria – available information.

Results

Descriptive statistics and reliability assessment. Table 4 summarizes the demographic characteristics of 128 respondents.

The sample consists of 69.5 percent of males and 30.5 percent of females. The disparity in the gender of the respondents can be explained by the fact that in Lithuania investment decisions are more often made by men when females are more active in saving and financial planning. Also, this disparity of gender in crowdfunding was found in previous research (Herve et al., 2019; Wallmeroth, 2019). So, a much lower percentage of females as investors in crowdfunding is not surprising. The age groups between 35 to 54 years account for the largest portion of the sample – 42.2 percent of respondents. It indicates that crowdfunding investors are typically middle age. Almost a half (49.2 percent) of respondents earn a net monthly salary that less than 1500 EUR. Yet 17 percent of respondents get more than 3000 EUR per month net salary. Respon-dents typically have a university degree (35.2 percent – bachelor's degree, 46.1 percent – Master's degree and 0.7 percent – PhD degree).

Table 4. **Demographic profile of the survey respondents**

Profile	Groupe	Frequency	%
Gender	Male	89	69.5
	Female	39	30.5
Age	18–34	54	42.2
	35–54	64	50
	More than 55	10	7.8
Neto monthly income	Less than 1500 Euro	63	49.2
	1501–3000	43	33.6
	More than 3001	22	17.2
Education	Professional, secondary	23	18
	Bachelor's degree	45	35.2
	Master, PhD degree	60	46.8
Occupation	Student	7	5.5
	Self-employed	28	21.7
	Employee	89	69.5
	Others (retired, unemployed)	4	2.3
Residence	One of the largest cities in Lithuania	102	79.7
	Other's cities	10	7.7
	Village	8	6.3
	Abroad	8	6.3
Interface with finance sector	Yes	44	34.3
	No	84	65.7

Most respondents work as employees (69.5 percent) while 22.5 percent of respondents are self-employed. Respondents typically live in one of the five biggest Lithuanian cities (79.6 percent) while just 6 percent of respondents live in the village. While analyzing the demographic profile of respondents, it was questioned if respondents relate to the financial sector. The results revealed that the majority of respondents (65.7 percent) are not related to the finance sector. A typical investor in real estate crowdfunding in Lithuania has been identified based on demographic characteristics of respondents: a man between the age of 25 and 34, who has a master's degree, lives in one of the five largest Lithuanian cities, works in a company as an employee, earns more than the Lithuanian average monthly net salary, and is not from the finance sector.

Before analyzing data more deeply, the reliability of the collected data was performed. Table 5 represents reliability statistics for the constructs, means and standard deviations.

Cronbach alpha measures the inter reliability of scales that are generated from several items. According to data presented in Table 5, there is a high correlation among all the items in risk and return criteria scale. The value of Cronbach alpha for this construct was higher than the recommended value of 0.7 suggesting that all 9 items in the risk and return criteria construct were closely related. The Cronbach alpha for behavioral biases construct was 0.62 suggesting that the reliability of this was questionable. However, according to M. M. Mohamad et al. (2015) in social sciences, Cronbach alpha above 0.6 is also acceptable and behavioral biases construct could be used for further analysis. Considering the means, the mean of risk and return criteria scale was 3.54 suggesting that not all respondents agreed that they evaluated risk and return criteria before making a crowdfunding investment decision. Moreover, the inter reliability of the scale also was measured in financial knowledge and Cronbach alpha value 0.74 indicate that all 4 statements in financial knowledge scale were closely related.

Assessment of investor rationality. To assess how rational the Lithuanian investors are in making real estate crowdfunding decisions, firstly descriptive analysis of return and risk and behavioral biases criteria was conducted based on their demonstrated decision-making behavior (as presented in Table 3). Rational real estate crowdfunding investor behavior was identified in the cases, whereas investors made their investment decisions based on at least 5 return and risk criteria (out of 9) and did not demonstrate any behavioral biases. According to the descriptive analysis results, 19.5% of respondents did not demonstrate any behavioral bias while making investment decisions, still part of them did not consider more than 5 risk and return criteria

Table 5. **Reliability and descriptive statistics of constructs**

Factor	Cronbach's alpha		Descriptive statistics	
Scales	Items	α	Mean	Standard Deviation
Risk and return	9	0.90	3.54	0.75

before making crowdfunding investment decision. Therefore, as presented in Table 6. *18% of respondents were assigned as being rational in real estate crowdfunding investment decision making*. Irrational real estate crowdfunding investor behavior was identified in the cases, whereas investors do not take into consideration risk and return criteria and demonstrate all five behavioral biases. In this research, *3.9% of respondents considered as being irrational investors in real estate crowdfunding*. The remaining *78.1% of the investors in real estate crowdfunding were considered as having bounded rationality behavior.*

Since bounded rationality was founded as the predominant investor behavior, a cluster analysis was applied, which allowed to further group bounded rationality investors, according to their scores of risk and return and behavioral biases criteria. Clustering analysis identified 3 distinct bounded rationality clusters. Cluster 1 represents 35.1% of real estate crowdfunding investors who could be viewed as having bounded rationality on a rather rational side. Investors in Cluster 1 had high scores for risk and return criteria, yet they also demonstrated on average 1 behavioral bias, which, according to the reviewed literature, could be explained as temporary deviation from rationality due to the learning process or the specifics of real estate crowdfunding, as an innovative investment product. Investors in Cluster 2 (representing 32% of real estate crowdfunding investors) and Cluster 3 (11% respectively) could be viewed as being on a rather irrational side, as they demonstrated more behavioral biases and lower scores to risk and return criteria. Further exploration of behavioral biases disclosed that in our research the most common behavioral bias was familiarity. This bias was demonstrated by 74.2% of real estate crowdfunding investors, meaning that such investors mostly invest in real estate crowdfunding platforms operating in their country and to those which are already known to them.

Individual-level characteristics and crowdfunding investor rationality. Table 7 represents the results of the Chi-Square test which was used to test whether there is a significant relationship between individual-level characteristics of investors and the level of their rationality.

Table 6. **Results of real estate crowdfunding investor rationality assessment**

Cluster centres according to rationality criteria (indexed)	Rational behavior	Bounded rationality behavior			Irrational behavior
		Cluster 1	Cluster 2	Cluster 3	
Risk and return	0.92	0.71	0.30	0.37	0.19
Behavioral biases	0.00	0.27	0.54	0.19	1.00
Number of cases in each cluster (N=128)	23	45	41	14	5
As % of total investors	18%	35.1%	32 %	11%	3.9 %

Table 7. **Chi-Square test results for investor behavior rationality**

Variable	χ^2	p
Gender	3.648	0.456
Age group	6,008	0.646
Net income group	8.956	0.346
Education	4.230	0.836
Occupation	8.825	0.718
Residence	9.065	0.697
Interface with finance sector	2.217	0.696
Level of financial knowledge	53.133	0.000

The results indicated that the rationality of real estate investor behavior does not significantly differ across different individual-level characteristics, except for the level of investors' financial knowledge ($\chi^2 = 53.13$, $p = 0.00$). The significant influence of the investors' financial knowledge is in line with our conceptual assumptions, that rational investors are able take into consideration risk and return criteria and do this correctly, as they possess higher financial knowledge. Our results demonstrated that no investors, whose all financial knowledge answers were incorrect (1st level of financial knowledge) or who answered only one question of financial knowledge (2 level of financial knowledge) correctly, were classified as rational (Table 8). And vice versa, the vast part of irrational investors demonstrated very low financial knowledge. The results of the financial knowledge of bounded rationality investors were ambiguous. In general, the majority of the bounded rationality investors demonstrated quite high-level financial knowledge (i.e., level 4 and 5 which was present across all clusters) and, therefore, would be expected to behave more on a rational side. Yet further analysis of the criteria, especially of those in Clusters 2 and 3, suggested that bounded rationality is largely based on the established behavioral biases rather

Table 8. **Distribution of financial knowledge among the behavior rationality clusters**

Level of financial knowledge	Frequency (%) of population (N=128)				
	Rational behavior (n=23)	Bounded rationality behavior			Irrational behavior (n=5)
		Cluster 1 (n =45)	Cluster 2 (n =41)	Cluster 3 (n =14)	
1 level (0 statements)	0	0	4.9	0	40.0
2 level (1 statement)	0	0	0	6.7	60.0
3 level (2 statement)	13.0	22.2	22.0	21.4	0
4 level (3 statement)	36.0	17.8	14.6	42.9	0
5 level (4 statement)	50.0	60.0	58.5	35.7	0

than on failing to understand and apply of risk and return criteria.

Discussions

This research supports our initial assumption regarding the domination of bounded rationality across investors into innovative financial products as it confirmed that 78.1% of Lithuanian real estate crowdfunding investors make bounded rationality investment decisions. Our research used somewhat different and more complex view on how to assess investors rationality, yet it is in line with neoclassical and behavioral finance theories and support results of S. Agarwal and B. Mazumder (2013), H. Hong et al. (2004), A. Lefevre and M. Chapman (2017). Differently from previous research it explored a particular innovative investment pro-duct, therefore we believe that bounded rationality of investors could be possibly related to the characteristics of innovative financial products, time limitations to make a decision and the impact of the social environment. However, for this further research is required.

In this research we also found that demographic characteristics of investors in real estate crowdfunding such as gender, age, net income, education, occupation, residence and interface with finance sector were not statistically relevant to the rationality of real estate crowdfunding investors behavior. Such findings are not in line with the previous research (Gonzalez-Igual et al., 2021; Kumar and Goyal, 2016; Lin, 2011; Prasad et al., 2021), but this might be due to characteristics of innovative financial products or different methodology of rationality assessment. On the other hand, we found a statistically significant relationship between investor rationality and their financial knowledge. The negative relationship between financial knowledge and behavioral biases was also reported by S. Choudhary et al. (2021), N. Rasool and S. Ullah (2019), G. Suresh (2021), while positive relationship between higher financial knowledge and more rational investment decisions was reported by B. Gavurova et al. (2019).

This research surveyed one of the innovative financial investment products – real estate crowdfunding, yet to make more generalized conclusions it could be further expanded into the other crowdfunding products such as P2P lending or other type of innovative products. Also, the current research employed two groups of rationality assessment criteria – risk and return and behavioral biases. In the future the methodology could be further expanded to include criteria related to the use available information in decision making.

Conclusions

Our research aim was to assess how rational investors are in making their crowdfunding investment decisions and if investors with the similar rationality level share common individual-level characteristics. Investor rationality has its roots in neoclassical and behavioral economics and finance theories and explains the decision-making process of investment. In this research investors behavior was classified into rational, bounded rationality and irrational and was assessed

by two groups of criteria – those evaluating investment risk and return and those detecting beha-vioral biases of investors. We assumed, that due to the complex crowdfunding investment environment, limitations of investor's cognitive abilities, and time constraint, real estate crowdfunding investors are not perfectly rational but rather demonstrate having bounded rationality behavior. Our approach and constructed rationality assessment criteria were employed in an on-line survey of Lithuanian real estate crowdfunding investors.

In line with our expectations, bounded rationality was proved to be the dominating form of investors' behavior for as much as 78.1% of respondents and just 18% of investors were considered as being rational. Furthermore, clustering of bounded rationality investors identified three distinct clusters and suggested that bounded rationality proved to be largely based on the established behavioural biases rather than on failing to understand and apply of risk and return criteria. Assessment of the individual-level characteristics identified that the differences between investor rationality in real estate crowdfunding can be explained by the investors' financial knowledge, but not by their demographic characteristics such as gender, age, net income, education, occupation, residence and interface with finance sector.

The research could be further expanded including an additional group of criteria related to the use available information in decision making and to survey other crowdfunding and other type of innovative financial products. As this research failed to prove the influence of demographic characteristics on the investor rationality, it would be relevant to explore the psychological, cognitive and social aspects of the investment decision-making, especially in innovative financial products. Furthermore, because the results show that investors in innovative financial products deviate from rational behavior and make biased investment decisions, their rationality is being linked to their financial knowledge, we believe that more regulation of such products, as well as a greater focus on financial education for such investors, is required.

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LIETUVOS SUTELKTINIO NT FINANSAVIMO INVESTUOTOJŲ ELGSENOS RACIONALUMO VERTINIMAS

Santrauka

Pastaruosius dešimtmečius finansų rinką ir joje veikiančių asmenų elgseną reikšmingai keičia technologinės inovacijos ir skaitmenizacijos procesai, didėjantis investavimo skirtingose rinkose prieinamumas bei nuolat atsirandantys inovatyvūs finansiniai produktai ir paslaugos. Inovatyvūs investiciniai produktai, tokie kaip sutelktinis investavimas į NT, nuo tradicinių skiriasi mažesne minimalios investicijos suma, lengvesne prieiga, skaitmeniniais sprendimais, didesne investavimo rizika, mažesniu produktų, paslaugų ir jų teikėjų reguliavimu ir kt. Dėl mažesnės minimalios investicijų sumos bei poreikio greitai priimti investicinius sprendimus inovatyvius finansinius produktus besirenkantys investuotojai yra mažiau linkę atlikti išsamią investicinę analizę nei investuojantys į tradicinius produktus (Block ir kt., 2018, Buttice ir Vismara, 2021) ir yra labiau linkę nukrypti nuo racionalaus sprendimų priėmimo modelio.

Investuotojo elgsenos racionalumas yra aktuali problema, padedanti suprasti ne tik bendrą finansų rinkų reakciją bet ir tai, kaip priimami individualūs investiciniai sprendimai. Šiame tyrime vertinamas individualaus investuotojo požiūris remiantis neoklasikine naudingumo maksimizavimo teorija, pagal kurią racionalūs investavimo sprendimai priimami atsižvelgiant į rizikos ir grąžos kompromisą, visą turimą informaciją bei nėra veikiami elgsenos šališkumų. Visgi dalis tyrėjų (Alimi, 2013; Gourinchas ir Parker, 2002; Lunfang ir kt., 2018, Thaler, 2016) kritikuoja arba atmeta neoklasikinės teorijos prielaidas teigdami, kad jos neatspindi realių rinkos sąlygų ir nepaaiškina šiuolaikinių investuotojų elgesio. Taigi, šiame tyrime, papildomai įvertinus elgsenos finansų literatūroje išsakytus argumentus (Tuyon ir Ahmad, 2018, Kumar ir Goyal, 2016, Lin, 2011), laikomasi požiūrio, kad tikrovėje tobulas investuotojų racionalumas neegzistuoja ir priimdami investicinius sprendimus finansų rinkos dalyviai yra šališki. Investuotojai, ypač besirenkantys inovatyvius finansinius produktus, neturi galimybių priimti racionalius sprendimus, nes jie susiduria su informacijos, laiko, kognityvinių gebėjimų ribotumu, nebūtinai kas kartą siekia maksimizuoti naudą, – greičiau tenkina savo poreikius ir priima sprendimus, kurie yra pakankamai geri esamomis aplinkybėmis.

Buvo siekiama įvertinti, kiek racionalūs yra investuotojai priimdami sprendimus investuoti į

nekilnojamo turto (NT) sutelktinio finansavimo platformas, taip pat ar panašaus racionalumo investuotojai pasižymi panašiomis individualiomis charakteristikomis. Apjungiant neoklasikinės ir elgsenos finansų teorijos nuostatas investuotojų elgsena buvo suskirstyta į tris racionalumo grupes – racionalius, riboto racionalumo ir iracionalius investuotojus. Racionalumo lygiui vertinti pasitelkti dviejų tipų vertinimo kriterijai – rizikos ir grąžos bei elgsenos šališkumų kriterijai. Racionalumo vertinimo logika ir sukonstruoti racionalumo vertinimo kriterijai buvo pritaikyti atliekant Lietuvos nekilnojamojo turto sutelktinio finansavimo investuotojų internetinę apklausą. Surinktų duomenų analizei panaudoti aprašomosios statistikos, hierarchinės klasterinės analizės bei $\chi 2$ (chi kvadrato) statistiniai metodai.

Tyrimo rezultatai patvirtino mūsų lūkesčius dėl investuotojų riboto racionalumo elgsenos dominavimo sutelktinio NT finansavimo. Net 78,1 proc. apklaustųjų buvo priskirti riboto racionalumo investuotojų grupei, o racionalių investuotojų grupę sudarė vos 18 proc. respondentų. Tolesnio riboto racionalumo investuotojų klasterizavimo metu išskirtos trys skirtingos grupės, ir tai leido įvertinti, kad ribotas racionalumas daugiausia buvo pagrįstas nustatytais elgesio šališkumais, o ne nesugebėjimu suprasti ir tinkamai taikyti rizikos ir grąžos kriterijų. Vertinant individualaus lygmens ypatybes nustatyta, kad sutelktinio NT finansavimo investuotojų racionalumo skirtumus galima paaiškinti investuotojų finansinių žinių, bet ne jų demografinių charakteristikų, tokių kaip lytis, amžius, grynosios pajamos, išsilavinimas, profesija, gyvenamoji vieta ir sąsaja su finansų sektoriumi, skirtumais.

Tyrimas gali būti toliau plėtojamas įtraukiant papildomą racionalumo vertinimo kriterijų grupę, susijusią su turimos informacijos panaudojimu priimant sprendimus bei tiriant kitus inovatyvius finansinius produktus, įskaitant kito tipo sutelktinio investavimo priemones. Kadangi šio tyrimo metu nepavyko įrodyti demografinių charakteristikų sąryšio su investuotojų racionalumu, būtų aktualu įvertinti psichologinius, kognityvinius ir socialinius investicinių sprendimų priėmimo aspektus, ypač inovatyvių finansinių produktų ypatumų kontekste. Kadangi tyrimo rezultatai atskleidė, kad investuotojai linkę nukrypti nuo racionalaus elgesio, investiciniai sprendimai buvo paveikti elgsenos šališkumų, o jų racionalumas buvo susijęs su turimomis finansinėmis žiniomis, tad manoma, kad būtų tikslinga griežčiau reguliuoti inovatyvius finansinius produktus ir paslaugas bei daugiau dėmesio skirti jų investuotojų finansiniam švietimui.