

No Limits? Effects of FOMO and Gamification on Individual Investment Behaviour in Neo-broker Stock Trading

Bomnüter, Udo; Kleinselbeck, Brigitte; Reusch, Heiko; Schmidt, Hendrik

Erstveröffentlichung / Primary Publication

Konferenzbeitrag / conference paper

Empfohlene Zitierung / Suggested Citation:

Bomnüter, U., Kleinselbeck, B., Reusch, H., & Schmidt, H. (2023). No Limits? Effects of FOMO and Gamification on Individual Investment Behaviour in Neo-broker Stock Trading. In F. Haumer, C. Kolo, & J. Mütterlein (Eds.), *Reorganization of Media Industries: Digital Transformation, Entrepreneurship and Regulation* (pp. 1-18). München: Deutsche Gesellschaft für Publizistik- und Kommunikationswissenschaft e.V. <https://doi.org/10.21241/ssoar.90870>

Nutzungsbedingungen:

Dieser Text wird unter einer CC BY Lizenz (Namensnennung) zur Verfügung gestellt. Nähere Auskünfte zu den CC-Lizenzen finden Sie hier:
<https://creativecommons.org/licenses/by/4.0/deed.de>

Terms of use:

This document is made available under a CC BY Licence (Attribution). For more Information see:
<https://creativecommons.org/licenses/by/4.0>

No Limits? Effects of FOMO and Gamification on Individual Investment Behaviour in Neo-broker Stock Trading

Udo Bomnüter¹, Brigitte Kleinselbeck¹, Heiko Reusch¹, Hendrik Schmidt²

¹Macromedia University of Applied Sciences, Berlin, ²NAO Co-Investment GmbH, Berlin

Zusammenfassung

Gemäß der verhaltensorientierten Finanzmarkttheorie führen kognitive und emotionale Prozesse zu irrationalem Anlageverhalten. In unserer Studie untersuchen wir, wie spezifische Biases mit zwei aktuellen, Social-Media-bezogenen Erscheinungen interagieren: Die Angst, etwas Wesentliches zu verpassen ("Fear of missing out", FOMO), und Gamification. Dieser Zusammenhang ist besonders relevant für Nutzer von „Neo-Broker“-Apps wie Robinhood, die sich bei jungen Zielgruppen großer Beliebtheit erfreuen. Es liegen bereits einige Studien zu FOMO und Gamification vor. Allerdings gibt es bisher keine Forschung, welche die beiden Faktoren kombiniert und mit irrationalem Anlageverhalten in Verbindung bringt. Der Kontext der Neo-Broker-Plattformen bietet ein geeignetes Forschungsumfeld, weil diese eng in das Social-Media-Ökosystem eingebettet sind. Unsere Untersuchung zielt darauf ab, herauszufinden, wie sich Gamification und FOMO auf das Anlageverhalten von Neo-Broker-Usern auswirken. Die Ergebnisse deuten auf einen signifikanten, moderaten Effekt hin, welcher irrationale Tendenzen bei deutschen Privatanlegern verstärkt.

Keywords: Fear of missing out (FOMO), Gamification, Anlegerbias, Neo-Broker, Kleinanleger

Summary

According to behavioural finance, cognitive and emotional biases cause irrational trading behaviour. In our study, we investigate how specific biases interact with two recent, social media related phenomena: Fear of missing out (FOMO) and gamification. This relationship is particularly relevant for users of “neo-broker” apps like Robinhood, which have become very popular with young target groups. There are various studies on FOMO and gamification, however, so far there is no research combining both factors and linking them to irrational investing. The context of neo-brokers provides a suitable research environment as they are closely embedded in the social-media ecosystem. Our research aims to determine how gamification and FOMO impact neo-broker users’ investment behaviour. The findings indicate a significant moderate effect amplifying irrational tendencies among German retail investors.

Keywords: Fear of missing out (FOMO), gamification, investment biases, neo-brokers, retail investors

Introduction

A new type of fin-tech companies such as Robinhood have achieved an exceptional market performance since their launch in the mid-2010s. These so-called neo-brokers offer near commission-free stock trading on a convenient, seamless mobile app or website (Meyer et al., 2021). Due to their favourable conditions of use, neo-brokers particularly appeal to younger market segments (Oliver, 2021), fuelling a surge in retail trading that has contributed to short-term, erratic speculations on individual stocks (Coggan, 2021). Two phenomena are held responsible for this trend: Firstly, the increasing appearance of “FOMO buy” calls-to-action on social media. These are postings aimed at the fear of missing out (FOMO) on investment opportunities if a stock is not purchased immediately (Khan, 2021). Secondly, the integration of gamification, i.e., typical elements of game playing (Hamari et al., 2014), to incentivise financial decisions (Shrikanth, 2020). Industry experts blame FOMO and gamification for affecting retail investors’ behaviour, causing them to invest less rationally (e.g., Khan, 2021).

Research in this field is rare yet. While there is a large body of research on factors influencing agents’ or managers’ financial decisions (e.g., Kahnemann & Tversky, 1979; Odean, 1999; Prechter, 2001; Thowfeek et al., 2020), only few studies address FOMO effects on individual trading (e.g., Elhai et al., 2020; Huber & Hobart, 2019). Academic interest in trading app users’ behaviour is only beginning to form (e.g., Potsaid & Venkataraman, 2022). Likewise, few studies have addressed the potential impact of gamification in contemporary investment environments (e.g., Bayuk & Altobello, 2019; Pal et al., 2021). Only van der Heide & Želinský (2020) critically discuss societal consequences of gamification in day-trading apps.

Our study is the first to link FOMO and gamification to investment decisions via social media platforms, particularly among non-professional users of neo-broker apps (NBA). Following an extensive literature review, we create a conceptual framework for explaining irrational trading behaviour of German retail investors through media-related effects of FOMO and gamification.

For our study, we apply a cross-sectional design of data collection. Based on an online survey with 735

participants, we examine the data set using OLS regression. Perceived FOMO in trading situations and response to gamification are defined as explanatory variables and types of biases in investment decisions as response variables. We also consider trading frequency, trading experience, age, and gender as potential confounders. Our findings indicate limited effects on irrational trading behaviour mostly of FOMO, while hinting at weak moderating influences of trading experience and frequency.

In the implications part, we discuss how neo-brokers might use such insights to optimise their value proposition while considering the introduction of governance mechanisms to prevent negative side effects. Beyond practical implications, our findings are intended to contribute to conceptualising the investment sector’s current transformation with regard to the interaction between digital platforms and their affordances, and psychological factors and processes underlying actual investment behaviour.

Literature Review

After a brief overview of the business model and user characteristics of neo-brokers, our review addresses three strands of literature, i.e., behavioural finance, gamification, and FOMO.

Neo-brokers

Neo-brokers are a new generation of financial intermediaries. They operate online platforms mediating orders to buy or sell various assets (e.g., stocks, options, exchange-traded funds, or cryptocurrencies). Instead of executing orders themselves, neo-brokers route them to third parties, i.e., market makers, for execution. Between the actual time of purchase with the corresponding asset price and the execution of the order, a discrepancy arises, the so-called bid-ask-spread. Market makers generate revenues from this spread, which they share with the neo-brokers. This revenue model is called “payment-for-order-flow” (Frölich & Lembach, 2021; Meyer et al., 2021).

Neo-brokers offer near commission-free trading due to their cost-efficient IT infrastructure, specialisation in a limited number of market makers and stock exchanges, and restricted services. Users can conveniently place orders via a smartphone trading app or a browser-based web trader (Frölich & Lembach, 2021; Meyer et al.,

2021). Their favourable terms and conditions and their use of gamified features make NBAs particularly appealing to younger market segments (Oliver, 2021; van der Heide & Želinský, 2020).

Two prominent examples are the German neo-broker Trade Republic, founded in 2013, and the U.S. company Robinhood, founded in 2015. Both are app-focused and offer their services either for a minimal flat fee per order like Trade Republic (2022) or even commission-free like Robinhood (2022a). As of December 2021, Robinhood registered 17.8 million active users in the U.S. (Robinhood, 2022b) compared to Trade Republic's more than one million users in six European countries (Trade Republic, 2022). According to a 2021 survey among German Trade Republic users, almost 70% are younger than 35 years, and 84.3% are male. More than half have invested in capital markets for the first time. On average, novice investors invested 37% of their private wealth. Almost 30% belong to households in the lower half of the income distribution. Regarding their motives, most (72%) stated that they see their investment as long-term savings, while 34% attached great importance to short-term gains. 20% admitted they primarily enjoy the thrill of investing (Kritikos et al., 2022).

Behavioural finance

For long, economic and financial theories centred around the axioms that investors would act rationally and consider all relevant information when making investment decisions. (Nagy & Obenberger, 1994; Thowfeek Ahamed et al., 2020). These principles were first presented in the neoclassical "Expected Utility Theory" (EUT) developed by von Neumann and Morgenstern (1944), who postulated that investors would take financial decisions in a way that maximises expected return while minimising risk at the same time – a view, most neoclassical theorists have shared subsequently (e.g., Fama, 1970; Markowitz, 1952).

"Behavioural finance" as a subdiscipline of behavioural economics contrasts with neoclassical finance. The term describes explanatory approaches that investigate psychological and sociological influences on the decision-making processes of individuals, groups, and organisations (Baker & Nofsinger, 2010; Shukla et al., 2020) to explain real-world phenomena of stock markets (Thaler, 1999). Behavioural finance theory emerged only in the 1980s with the research of psychologists Kahneman and Tversky. Inspired by findings on heuristics affecting judgements (Tversky &

Kahnemann, 1974), Kahneman and Tversky (1979) introduced Prospect Theory (PT), which is considered one of the most influential models in the field of decision-making under risk (cf. Barberis, 2013; Zahera & Bansal, 2018).

PT frames value to gains and losses instead of final assets. It suggests that decision-makers, when evaluating possible, certain, or probable gains and losses, rather follow a risk-averse path in the case of positive events (gains) while opting for risk-seeking in choices involving sure losses. They are prone to evaluating changes in outcome rather than absolute magnitude, furthered by limited abilities to distinguish between certainty and probabilities (Kahneman & Tversky, 1979). Subsequently, PT was advanced into "Cumulative Prospect Theory" (CPT), which employs a cumulative weighting function and extends to uncertain and risky prospects. It suggests four types of risk attitudes: risk aversion for gains of high probability and losses of low probability; risk seeking for gains of low probability and losses of high probability (Tversky & Kahneman, 1992). Other authors challenged the traditional axioms of EUT to better understand anomalies in financial markets arising from psychological factors (Kapoor & Prosad, 2017; Statman, 2014). The following section reviews the main biases in behavioural finance, thus concentrating on the micro-perspective relevant to this study.

Behavioural biases in financial decision-making

Behavioural biases fall into two broad categories, emotional and cognitive, both leading to irrational assessments. Examples for the first category are regret aversion, loss aversion, confirmation bias, and self-control bias, while overconfidence, anchoring, herding, or framing are examples for cognitive biases. Cognitive biases include heuristics, often referred to as mental shortcuts, which simplify complex decision-making processes and reduce the cognitive resources required for problem-solving (Pompian, 2006).

Various studies list numerous behavioural biases, which appear to overlap or sometimes even conflict with each other (Davies & Brooks, 2017). Analysing 123 research articles, Zahera and Bansal (2018) identified 17 biases, of which overconfidence, disposition effect, herding effect, and loss aversion gained the highest research interest.

Considering the complexities of delimiting the full

range of biases, the following outline focuses on five pronounced biases, which have all been related to FOMO respectively gamification in recent studies (Barber et al., 2020; Barton et al., 2015; Han, 2019; Mesly & Racicot, 2017; Oyster, 2018).

Overconfidence

Overconfidence is defined as people's overestimation of their abilities to successfully perform a task or by an overrating of their performance relative to that of others (American Psychological Association [APA], n.d.-a). As evidenced by Odean (1998) and Phan et al. (2020), there appears to be a causal relationship between stock gains and trading volume attributable to overconfidence bias. An increase in gains leads investors to have more confidence in the stock and trade more aggressively. Overconfident investors tend to overreact to private information while undervaluing public information. They are also more likely to trade risky assets because they misjudge the risk (Phan et al., 2020).

Disposition effect

Shefrin and Statman (1985) first formally investigated the disposition effect in the context of mutual fund trading. They propose that people hold stocks with gains too short and stocks with losses too long because investors do not perceive the outcomes objectively (Odean, 1999). Recent studies support the disposition effect. Brettschneider et al. (2021) find that investors are more likely to sell a gaining stock when the proportion of losing stocks in their portfolio is high. Moreover, their propensity to realise a stock is higher on the same day when selling another stock.

Herding bias

Baddeley (2010) defines herd behaviour as "the phenomenon of individuals deciding to follow others and imitating group behaviours rather than deciding independently and atomistically on the basis of their own, private information" (p. 282). In stock markets, investors tend to follow decisions by other investors rather than relying on self-collected information (Zahera & Bansal, 2018). This appears less evident for institutional investors than for retail investors (Merli & Rogers, 2013). However, even professional traders show herding in uncertain stock markets (Cipriani & Guatino, 2008).

Herding continues to develop online, where social

media facilitates information sharing. Aloosh et al. (2021) provide evidence that herding occurs beyond brief short squeeze periods caused by social media as a key source of information.

Anchoring bias

Anchoring can be defined as a "common human tendency to rely too heavily, or "anchor" on one trait or piece of information when making decisions" (Zaiane, 2015, p. 14). In the context of trading, investors tend to be slow to adjust when new information is presented because their decision is anchored by previous observations (Zaiane, 2015), e.g., a stock's acquisition price. The anchoring bias is more likely to occur in situations under uncertainty or risk (Kahneman & Tversky, 1979). One of the reasons is that individuals tend to overestimate the probability of conjunctive events compared to disjunctive events.

Gambler's fallacy

Gambler's fallacy occurs when people fail to recognise the independence of chance events, leading to the erroneous belief that a chance event's outcome can be predicted based on previous events (APA, n.d.-b). This is caused by a subjective probability assessment that an outcome is due in a series of chance events and is more likely to appear than by random chance (Sundali & Croson, 2006). The underlying principle, representativeness bias, is a cognitive heuristic that endows people with a fast response reflex based on past experiences that appear (erroneously) familiar (Kahneman & Tversky 1972, 1979). In the context of financial behaviour, gambler's fallacy comes into play when a similarity between random processes is wrongly interpreted by an investor as a predictive relationship (Rakesh, 2013). There is evidence that financial literacy has a negative effect on gambler's fallacy (Rasool & Ullah, 2020).

In summary, PT and its derivatives do not deny that investment decisions should be rational. However, they show that there are behavioural biases strong enough to trigger irrational investment decisions. This happens at a rather subconscious level, while an investor may assume to act rationally. Investing biases in turn are caused by various factors. Besides traditional personality traits, which may influence an investor's likelihood to engage in risk-prone or risk-averse investment behaviour (Aren & Nayman Hamamci, 2020), these include FOMO and gamification.

Fear of missing out (FOMO)

The concept of “fear of missing out” (FOMO) is a global psychological phenomenon that has been related to the use of social media (Gupta & Sharma, 2021). First explored by marketing strategist Dan Herman (2000) in the context of brand loyalty, the concept refers to an individual’s “pervasive apprehension that others might be having rewarding experiences from which one is absent”, linked to the “desire to stay continuously connected” with others’ activities (Przybylski et al., 2013, p. 1841). Following the perception of missing out on something, the affected person will behave compulsively to maintain their social connections. (Gupta & Sharma, 2021).

FOMO has been conceptualised by Przybylski et al. (2013) using self-determination theory (SDT), developed by Deci and Ryan (1985), as an approach to human motivation and personality. SDT examines factors influencing intrinsic motivation, self-regulation, and mental well-being based on the fulfilment of innate psychological needs, i.e., competence, autonomy, and relatedness with others (Ryan & Deci, 2000). Przybylski et al. (2013) propose that FOMO results from deficits in satisfying these needs. Combining results from three studies, they demonstrate that perceiving lower levels of needs fulfilment will lead to higher levels of FOMO, which are associated with increased social media engagement, especially among younger males.

In their research review, Alutaybi et al. (2020) identify five primary contexts where social media users experience FOMO and the associated fears. Table 1 (*Appendix*) provides an overview.

Not every kind of FOMO is relevant in the context of this study. Our research focuses on the fear of missing out on investment-related information and the according trading gains, i.e., monetary rewards, rather than missing out on rewarding social experiences. This division is essential, as monetary rewards cannot simply be equated with social ones (e.g., Kahneman & Deaton, 2010; Clor-Proell et al., 2020). We identified seven kinds of FOMO in the classification by Alutaybi et al. (2020) that can be related to retail investment (cf. Table 1).

Retail investors with high levels of FOMO will be fundamentally averse to missing out on trading opportunities (Potsaid & Venkataraman, 2022), especially in social environments where friends or

family “brag” about their trading profits (Jennings, 2021; Laurent, 2021). Likewise, perceiving posts and mentions from others currently investing in a stock and making profits while not investing themselves is expected to create FOMO among users. This will presumably positively affect users’ willingness to invest themselves, even if the stock in question is already overvalued (Delfabbro et al., 2021).

Gamification

The term “gamification” came to prominence in the early 2010s and refers to the “transfer and use of game design elements in non-game contexts” (Deterding et al., 2011, p.1). In contrast to fully developed games, gamification borrows singular game design elements and transfers them to different usage scenarios, analogue and digital alike. The central idea behind gamification is to trigger and influence user behaviour. Meta-analyses of existing studies by Hamari et al. (2014) and Looyestyn et al. (2017) show that gamification is linked to increased loyalty, motivation, and engagement. These positive effects can be measured in different areas, ranging from gamified language-learning apps (Dehghanzadeh et al., 2021) to health-related programmes (Cotton & Panel, 2019).

Underlying principles are shaping all games. Among those are voluntary participation, a stated objective, rules, and a feedback system (McGonigal, 2011). Especially the latter plays a central role in game design as the feedback system is applied to trigger motivation. SDT (see above) suggests that extrinsic rewards may negatively interact with intrinsic motivation if they are not task or performance-contingent and do not support competence, autonomy, and relatedness, and vice versa (Deci & Ryan, 2008, 2012).

Feedback in digital games is usually provided by the immediate display of performance-contingent progress numbers to trigger extrinsic and intrinsic motivation, thus ensuring that gamers continue playing. For this reason, the design of rewards and feedback is central to game designers (Salen & Zimmerman, 2004; Schell, 2008). This intense focus on intrinsic and extrinsic motivation is also reflected in the design of gamified applications and interfaces (Alsawaier, 2018; Mekler et al., 2017), where game components such as badges, high scores, progress bars, and leaderboards are extensively used. They create a “feedback loop”, ensuring that players receive permanent reward feedback (Deterding, 2015, p. 39). This interaction stimulates extrinsic motivation since received points

provide an immediate assessment of a user's performance, whereas badges show a user's consistency, and leaderboards enable a competitive comparison to other users (Linehan et al., 2015).

Sailer et al. (2017) conducted an experiment which showed that feedback features, including badges or leaderboards, positively impacted user behaviour. Moreover, game design elements that provide prompt feedback were considered more significant than other components.

The adoption of game design elements in e-banking was investigated early by Rodrigues et al. (2016). In their study, they found that bank customers were willing to accept and use gamified applications to manage their investments, with ease of use, enjoyment and perceived socialness as central factors.

Conceptual Framework

Neo-brokers like Robinhood or Trade Republic make it easy and inexpensive to enter the stock market. They use gamification elements such as those described above. Additionally, they benefit from FOMO-related calls-to-action that create high demand for certain stocks traded at NBAs. Our research model links FOMO and gamification to behavioural biases in investment decision making among NBA users. Since these biases result from using NBAs and associated social media channels, they can be framed as online media effects on financial markets (Agarwal et al., 2019).

In the given context, the criterion variable, irrational investment behaviour (IIB), comprises all five investing biases outlined above, each capturing a different aspect of retail investment behaviour:

Overconfidence bias assumes that investors tend to overestimate their ability to perform a task successfully while misjudging the risk. (APA, n.d.-a; Phan et al., 2020)

Disposition effect refers to an irrational aversion to loss realisation. Investors tend to sell winners/gains too early and hold losses too long (Odean, 1998; Shefrin & Statman, 1985).

Anchoring bias is the irrational tendency to rely too heavily on past information when making decisions. Consequently, investors tend to be slow to adjust. (Zaiane, 2015).

Herding bias involves the irrational alignment of one's behaviour with the behaviour of others rather than relying on independent information, despite the risk of reduced returns (Merli & Rogers, 2013; Zahera & Bansal, 2018).

Gambler's fallacy occurs when a similarity between random processes is interpreted by investors as a predictive relationship between outcomes (Rakesh, 2013), thus leading to adverse investments.

We further distinguish between the descriptor variables FOMO and gamification used as factors for our research model.

FOMO, as the fear of missing out on (investment) opportunities, has been linked to mobile and social media early on (e.g., Grant & O'Donohoe, 2007; Przybylski et al., 2013). Neo-brokers as trading platforms are of particular importance in this study. Research by Potsaid et al. (2022) shows that restrictions to trading at NBAs affect retail investors with high FOMO levels more than those with low levels.

FOMO has been linked to overconfidence and risk-seeking (Bonaparte, 2021), herd behaviour and gambler's fallacy (Shiva et al., 2020), and loss aversion and herd behaviour (Gupta & Shrivastava, 2021), with a tendency to increase investing biases. This aligns with FOMO's general association with problematic technology, internet use, and negative affectivity (Elhai et al., 2021). Consequently, we expect FOMO to reinforce irrational investment behaviour.

H1: *Higher levels of trading-related FOMO among users of NBAs will have a positive impact on their IIB.*

Neo-broker trading apps such as Robinhood or Trade Republic employ several game design elements. For example, both NBAs display the stock portfolio as a general "score" and use animated badges which depict certain events, such as a friend invite. Additionally, Trade Republic offers a list of most popular stocks in the community, which can be considered a leaderboard. Overall, these gamification elements create a positive feedback loop which supposedly motivates users to continue trading.

Therefore, the predicting role of gamification is to be tested to show if and to what extent it can be a motivational driver.

H2: *Higher levels of gamification response among users of NBAs will have a positive impact on their IIB.*

In addition, we expect two other factors to strengthen or weaken the effects: Retail investors' frequency of trading and their experience on the stock market.

Trading frequency has been linked to several behavioural biases (Barber & Odean, 2001; Prosad et al., 2015). Therefore, we expect the frequency of trading to moderate the effects of FOMO and gamification.

H3a: *The frequency of trading (per time interval) will interact with FOMO and gamification with effects on retail investors' IIB.*

Likewise, studies have related trading experience to several investing biases (Chen et al., 2007; Huang & Goo, 2008; Kawshala et al., 2020). Drawing on these findings, we expect trading experience to moderate the effects of FOMO and gamification.

H3b: *Trading experience (in years) will interact with FOMO and gamification with effects on retail investors' IIB.*

We further incorporate age (in years) and gender as control variables in our model.

Figure 1 (*Appendix*) shows the complete research model with the descriptor variables FOMO and gamification, the two moderator variables, the two control variables, and the hypotheses presented.

Methodology

To address the research question and its hypotheses, OLS regression analysis was conducted according to our conceptual model (Fig. 1). Research design and sampling will be introduced in the following subchapters.

Research design

We created a standardised online questionnaire consisting of two sections. In the first section, a filter question ("Neo-broking activity") was asked to check for the participants' eligibility. We also sorted out respondents without any trading activities and infrequent social media users. The section further contained questions about participants' social media usage and average trading amount. In addition,

participants had to indicate their trading frequency and experience as possible moderator variables. Furthermore, we captured the demographic variables "Gender" and "Age" as possible confounders.

The second section measured independent and dependent variables using 5-point Likert scale questions. At first, the independent variables – gamification and FOMO – were addressed.

FOMO was measured based on the established FOMO scale by Przybylski et al. (2013). Considering their relatedness to trading behaviour discussed above, we reduced the original number of items to five with an overarching relevance. We then added two specifically investment-related items, drawing on the reflections by Clor-Proell et al. (2019) in their development of a scale to measure FOMO on investment information (I-FoMO). Table 2 (*Appendix*) overviews the final seven items and their association with the two concepts.

"Gamification" was measured using three items, each aiming at one of three interacting game-designing components: high scores (points), leaderboards (ranking), and badges as feedback display (Sailer et al., 2017).

Our dependent variable "Irrational Investment Behaviour" (IIB) was measured with an index value capturing the five biases: Overconfidence, disposition effect, anchoring bias, herd behaviour and gambler's fallacy. We used two items for each bias, except overconfidence and anchoring bias, which were measured with one item each to account for their assumed relatedness (e.g., Russo & Schoemaker, 1992).

Pre-test

To check the questionnaire's technical and content-related quality, including measurement validity, a pre-test was carried out in January 2022. A total of six retail investors, three male and three female, 20 to 38 years old, executed the pre-test. Due to their feedback, the instructions and wording of some of the questions were revised.

Sampling

According to a survey by the German Stock Institute, an estimated 12.1 million Germans are considered retail investors (Deutsches Aktieninstitut, 2022a). With an estimated 2.34 million people (Statista, 2022), the

share of neo-broker users is 19.3%. To address this population, we applied purposive sampling based on a concentration principle: Several Instagram accounts dedicated to stocks were contacted and asked to share the questionnaire with their followers (e.g., @techaktien with 122.000 followers).

From January 19 to 21, 2022, a total of 1,090 people took part in the online survey. After filtering for the use of neo-brokers, retail investment activities and regular social-media usage, 735 questionnaires were considered for further analyses.

Results

The respondents were on average 27 years old ($SD=6.23$ years). According to common classifications (e.g., Dimock, 2021), they can be divided into four age groups:

Generation Z born 1997-2012 ($n=346$)

Millennials born 1981-1996 ($n=376$)

Generation X born 1965-1980 ($n=11$)

Boomers born 1946-1964 ($n=2$)

In total, 677 respondents (92.1%) were male, 56 female, and two diverse. This gender and age discrepancy mirrors the actual dominance of young male users confirmed by other studies (e.g., Kritikos et al., 2022).

Regarding trading frequency, more than half of the respondents (51.7%) trade monthly, while 37.6% trade at least every two weeks, with only 10.7% trading every six months or less. More than a third (35.5%) have more than two years of trading experience, roughly 40% one to two years, and 24.6% have been trading for less than one year. The median investment per trade is between EUR 200 and 500, with 28.2% of the respondents investing more than EUR 500. 695 respondents (95%) access social media multiple times per day.

All five investing biases are present in our data set, ranging in their mean values from 1.6 to 3.7 on a scale from 1 to 5. However, the calculation of Cronbach's alpha for assessing the IIB scale's internal consistency led to excluding the items addressing overconfidence and anchoring bias. The adjusted index used in our analysis showed a mean value of 2.11 ($SD=0.63$). The

mean index values for the FOMO and gamification indices are 2.58 ($SD=0.75$) and 2.44 ($SD=1.07$), respectively.

Regression analysis

To validate our conceptual model, we applied stepwise OLS regression analysis. Table 3 (*Appendix*) reports the results.

The adjusted R^2 (.174) indicates that irrational investment behaviour (IIB) among neo-broker users is only partially explained by the model variables. Still, we find that FOMO ($b=.314$, $p<.001$) significantly relates to IIB in support of H1. Gamification, however, had to be excluded due to its weak contribution to the model. H2 is thus not supported. In addition, trading experience has a significant, albeit weak negative influence on IIB ($b=-.061$, $p<.001$) in support of H3b. There also is a significant but negligible effect of trading frequency on IIB ($b=.0006$, $p<.005$). We therefore partially confirm H3a. The inclusion of the control variables age and gender did not significantly impact the main results, thus affirming the robustness of our findings.

Discussion

By linking FOMO and gamification to established biases from behavioural finance, we tried to determine the obstructive impact of social-media related factors on investment decision-making among NBA users. Our results show that FOMO is the most important factor. This finding ties in with Shiva et al. (2020), underlining the relatedness of FOMO to investing biases. The effect on IIB is slightly mitigated by trading experience, which may be explained by learning effects and minimally strengthened by trading frequency, the latter indicating an increased engagement typically related to FOMO. Against our expectations, gamification did not substantially contribute to IIB. Considering these findings, the most relevant result of our study is that contrary to the criticism from practitioners (e.g., Khan, 2021) and academia (e.g., van der Heide & Želinský, 2020), FOMO and gamification affect the trading behaviour of NBA users only to a limited extent. The largest share of irrational investment behaviour seems to be caused by factors beyond this study, which are neither specific to neo-brokers nor social media related but rather part of users' personalities, with FOMO serving as a reinforcer.

Implications for managers

Our results provide several insights for managers of online-trading platforms. They indicate that perceived FOMO and susceptibility to gamification cannot fully explain irrational investing. NBA users may trade nearly as irrationally as other retail investors, with a moderate amplifying effect, especially from social media transmitted FOMO.

However, being limited in their effects on IIB does not diminish the appeal of features that explicitly employ FOMO and gamification concepts. Neo-brokers may benefit from combining favourable conditions of use with functions like message boards and gamification elements that conform to their young target groups' social media environment. For millennials and Gen Z, social media and digital services are essential to their lives. According to a PWC (2020) study, 95% of Gen Z consumers actively use social media.

Our results show that most neo-broker users are younger than the average shareholder in Germany (Deutsches Aktieninstitut, 2022b). Consistent with findings by Kritikos et al. (2022), there is a clear indication that neo-brokers enable young adults to participate in capital markets. Moreover, the respondents' trading frequency is relatively high, with 89.3% trading at least monthly, while 28.2% invest more than EUR 500 per trade. Overall, NBA users form a very attractive target group, especially considering their customer lifetime value.

Regarding the vulnerability of young social media users to FOMO in general and the discovered amplification of IIB through FOMO, corporate social responsibility must be considered, too. As FOMO has been related to detrimental effects on people's well-being (e.g., Przybylski et al., 2013), neo-brokers might want to take protective measures for their users to avoid a bad reputation. They might either refer to concepts from the "FOMO Reduction method" (FoMO-R) suggested by Alutaybi et al. (2020), e.g., through explicit ethical conducts; or employ governance mechanisms, e.g., by managing message boards and providing additional real-time information.

Limitations and future research

It should be noted, though, that our data collection used purposive sampling based on the social platform Instagram, which might result in limitations of the results' representativeness despite matching specific

sample characteristics with secondary data. Future studies should aim to employ random sampling instead. Furthermore, our sample's share of female and diverse users is less than 8%. This may have been too small to allow for significant effects based on gender differences found in related studies (e.g., Barber & Odean, 2001; Przybylski et al., 2013). Subsequent studies could increase non-males' shares to investigate such effects. Alternatively, for enlarging the scope of research, the number and kind of biases addressed might be varied and connected to quantitative financial outcomes.

Another research area linked to central aspects of our study would be investigating factors that determine the choice of neo-brokers compared to traditional trading services and whether social media, FOMO and gamification elements play a role in this choice. Our research may also be fruitfully expanded to behavioural factors of investments in cryptocurrencies and NFTs, which have increased in popularity, particularly among younger investor groups.

As these limitations and suggestions exemplify, there is a need for future research, especially considering the current transformations of the financial sector in Germany and beyond.

References

- Agarwal, S., Kumar, S., & Goel, U. (2019). Stock market response to information diffusion through internet sources: A literature review. *International Journal of Information Management*, 45, 118-131. <https://doi.org/10.1016/j.ijinfomgt.2018.11.002>
- Aloosh, A., Choi, H. E., & Ouzan, S. (2021). *Meme Stocks and Herd Behavior*. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.3909945>
- Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, 35(1), 56-79. <https://doi.org/10.1108/IJILT-02-2017-0009>
- Alutaybi, A., Al-Thani, D., McAlaney, J., & Ali, R. (2020). Combating fear of missing out (FoMO) on social media: The fomo-r method. *International journal of environmental research and public health*, 17(17), 6128. <https://doi.org/10.3390/ijerph17176128>
- American Psychological Association. (n.d.-a). APA Dictionary of Psychology - Overconfidence. Retrieved

- May 9, 2022, from <https://dictionary.apa.org/overconfidence>
- American Psychological Association. (n.d.-b). APA Dictionary of Psychology – Gambler's Fallacy. Retrieved May 9, 2022, from <https://dictionary.apa.org/gamblers-fallacy>
- Baddeley, M. (2010). Herding, social influence and economic decision-making: socio-psychological and neuroscientific analyses. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1538), 281-290. <https://doi.org/10.1098/rstb.2009.0169>
- Baker, H. K., & Nofsinger, J. R. (2010). Behavioral finance: An overview. In H. K. Baker and J. R. Nofsinger (eds.), *Behavioral science: Investors, corporations and markets* (pp. 3-21). John Wiley & Sons.
- Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *The quarterly journal of economics*, 116(1), 261-292. <https://doi.org/10.1162/003355301556400>
- Barber, B. M., Huang, X., Odean, T., & Schwarz, C. (2020). *Attention Induced Trading and Returns: Evidence from Robinhood Users*. SSRN Electronic Journal. <https://ssrn.com/abstract=3715077>.
- Barberis, N. C. (2013). Thirty years of prospect theory in economics: A review and assessment. *Journal of Economic Perspectives*, 27(1) 173-196. <http://dx.doi.org/10.1257/jep.27.1.173>
- Barton, M., Symborski, C., Quinn, M., Morewedge, C. K., Kassam, K. S., & Korris, J. (2015, May). *The use of theory in designing a serious game for the reduction of cognitive biases* [Paper presentation]. Digital Games Research Association (DiGRA) Conference 2015, Lüneburg, Germany.
- Bayuk, J., & Altobello, S.A. (2019). Can gamification improve financial behavior? The moderating role of app expertise. *International Journal of Bank Marketing*, 37(4), 951-975. <https://doi.org/10.1108/IJBM-04-2018-0086>
- Bonaparte, Y. (2021). *FOMO Index: A Cross Sectional and Time Series Analyses*. SSRN Electronic Journal. <http://dx.doi.org/10.2139/ssrn.3924594>.
- Brettschneider, J., Burro, G., & Henderson, V. (2021). Wide framing disposition effect: An empirical study. *Journal of Economic Behavior & Organization*, 185, 330-347. <https://doi.org/10.1016/j.jebo.2021.03.003>
- Chen, G., Kim, K. A., Nofsinger, J. R., & Rui, O. M. (2007). Trading performance, disposition effect, overconfidence, representativeness bias, and experience of emerging market investors. *Journal of behavioral decision making*, 20(4), 425-451. <https://doi.org/10.1002/bdm.561>
- Chhapra, I. U., Kashif, M., Rehan, R., & Bai, A. (2018). An empirical investigation of investor's behavioral biases on financial decision making. *Asian Journal of Empirical Research*, 8(3), 99-109. <https://doi.org/10.18488/journal.1007/2018.7.3/1007.3.99.109>
- Cipriani, M., & Guarino, A. (2008). Herd behavior in financial markets: An experiment with financial market professionals. *IMF Working Papers*, 08(141), 1-28.
- Clor-Proell, S. M., Guggenmos, R. D., & Rennekamp, K. (2020). Mobile devices and investment news apps: The effects of information release, push notification, and the fear of missing out. *The Accounting Review*, 95(5), 95-115.
- Coggan, P. (2021, Aug. 26). Welcome to the great speculative era. *Financial Times*. <https://www.ft.com/content/95fd431f-fd97-4380-9349-5a3261f46f39>
- Cotton, V., & Patel, M. S. (2019). Gamification use and design in popular health and fitness mobile applications. *American Journal of Health Promotion*, 33(3), 448-451. <https://doi.org/10.1177/0890117118790394>
- Davies, G. B., & Brooks, P. (2017). Practical Challenges of Implementing Behavioral Finance: Reflections from the Field. In H. K. Baker, G. Filbeck, and V. Ricciardi (eds.), *Financial Behavior: Players, Services, Products, and Markets* (pp. 542-560). Oxford University Press.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.
- Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie Canadienne*, 49(3), 182. <http://dx.doi.org/10.1037/a0012801>

- Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (eds.), *Handbook of theories of social psychology* (pp. 416-436). Sage Publications.
- Dehghanzadeh, H., Fardanesh, H., Hatami, J., Talaei, E., & Noroozi, O. (2021). Using gamification to support learning English as a second language: a systematic review. *Computer Assisted Language Learning*, 34(7), 934-957. <https://doi.org/10.1080/09588221.2019.1648298>
- Delfabbro, P., King, D. L., & Williams, J. (2021). The psychology of cryptocurrency trading: Risk and protective factors. *Journal of Behavioral Addictions*, 10(2), 201-207. <http://dx.doi.org/10.1556/2006.2021.00037>
- Deterding, S. (2015). The Ambiguity of Games: Histories and Rhetorics of a Gameful World. In S. P. Walz & S. Deterding (Eds.), *The gameful world: Approaches, issues, applications* (pp. 23-64). MIT Press.
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining “gamification”. *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*, 9-15. <https://doi.org/10.1145/2181037.2181040>
- Deutsches Aktieninstitut (German Stock Institut) (2022a, Jan. 19). *Shareholder numbers 2021: Continuing at a high level*. DAI. <https://www.dai.de/en/shareholder-numbers/#/en/publications/translate-to-english-dokumenttitel/aktionaerszahlen-2021-weiter-auf-hohem-niveau>
- Deutsches Aktieninstitut (German Stock Institute) (2022b, Jan. 19). *Deutschland und die Aktie*. DAI. https://www.dai.de/fileadmin/user_upload/220119_Aktionaerszahlen_2021_Deutsches_Aktieninstitut.pdf
- Elhai, J. D., Haibo, Y., & Montag, C. (2020). Fear of missing out (FOMO): Overview, theoretical underpinnings, and literature review on relations with severity of negative affectivity and problematic technology use. *Brazilian Journal of Psychiatry*, 43(14), 203-209. <https://doi.org/10.1590/1516-4446-2020-0870>
- Fama, E.F., (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, 25(2), 383-417.
- Frölich, L., & Lembach, J. (2021, July 22). The promises neo-brokers make – and the ones they keep. BaFin (Federal Financial Supervisory Authority). https://www.bafin.de/SharedDocs/Veroeffentlichungen/EN/Fachartikel/2021/fa_bj_2106_Neo_Broker_en.html
- Gupta M, & Sharma A. (2021). Fear of missing out: A brief overview of origin, theoretical underpinnings and relationship with mental health. *World Journal of Clinical Cases* 2021, 9(19), 4881-4889. <https://doi.org/10.12998%2Fwjcc.v9.i19.4881>
- Grant, I., & O'Donohoe, S. (2007). Brand in the hand or sand in the hand? A contextualised account of adolescents' mobile phone consumption. *NA - Advances in Consumer Research*, 34, 280-285.
- Gupta, S., & Shrivastava, M. (2021). Herding and loss aversion in stock markets: mediating role of fear of missing out (FOMO) in retail investors. *International Journal of Emerging Markets*. Advance online publication. <https://doi.org/10.1108/IJOEM-08-2020-0933>
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does gamification work? A literature review of empirical studies on gamification* [Paper presentation]. 47th Hawaii International Conference on System Sciences (HICSS) 2014, Waikoloa, HI. <https://doi.org/10.1109/HICSS.2014.377>
- Han, Z. (2019). *The Role of Dynamic Incentives in Customer Engagement: Applications in Gaming and Gamification* (Publication No. 27765931) [Doctoral dissertation, Emory University]. ProQuest Dissertations Publishing.
- Haryanto, S., Subroto, A., & Ulpah, M. (2020). Disposition effect and herding behavior in the cryptocurrency market. *Journal of Industrial and Business Economics*, 47(1), 115-132. <https://doi.org/10.1007/s40812-019-00130-0>
- Herman, D. (2000). Introducing short-term brands: A new branding tool for a new consumer reality. *Journal of Brand Management*, 7(5), 330-340. <https://doi.org/10.1057/bm.2000.23>
- Hirshleifer, D. A., & Teoh, S. H. (2002). *Limited attention, information disclosure, and financial reporting*. SSRN Electronic Journal. <http://dx.doi.org/10.2139/ssrn.334940>

- Hotar, N. (2020). Herd behavior in terms of social psychology: The example of crypto asset markets. *International Journal of eBusiness and eGovernment Studies*, 12(1), 79-90. <http://dx.doi.org/10.34111/ijegeg.202012106>
- Huang, C. L., & Goo, Y. J. (2008). Are happy investors likely to be overconfident? *Emerging Markets Finance and Trade*, 44(4), 33-39.
- Huber, T., & Hobart, B. (2019). *Manias and Mimesis: Applying René Girard's Mimetic Theory to financial bubbles*. SSRN Electronic Journal. <http://dx.doi.org/10.2139/ssrn.3469465>
- Hussain, M., Shah, S. Z. A., Latif, K., Bashir, U., & Yasir, M. (2013). Hindsight bias and investment decisions making: Empirical evidence form an emerging financial market. *International Journal of Research Studies in Management*, 2(2), 77-88. <http://dx.doi.org/10.5861/ijrsm.2013.323>
- Jennings, J. (2021, Feb. 17). Investors, don't succumb to the Fear Of Missing Out. *Forbes*. <https://www.forbes.com/sites/johnjennings/2021/02/17/investors-dont-succumb-to-the-fear-of-missing-out/?sh=7ce51c976349>
- Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. *Psychological and Cognitive Sciences*, 107(38), 16489-16493. <https://doi.org/10.1073/pnas.1011492107>
- Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology*, 3(3), 430-454.
- Kahneman, D., & Tversky, A. (1979). Prospect Theory: An analysis of decision under risk. *Econometrica*, 47(2), 263-292.
- Kapoor, S., & Prosad, J. M. (2017). Behavioral finance: A review. *Procedia Computer Science*, 122, 50-54. <https://doi.org/10.1016/j.procs.2017.11.340>
- Kawshala, B. H., Anuradha, N., & Shamil, M. M. (2020). Socio-economic, trading sophistication and self-reflection on investors' herding bias: Evidence from Colombo stock exchange. *International Journal of Management, Innovation & Entrepreneurial Research*, 6(2), 128-138. <https://doi.org/10.18510/ijmier.2020.6212>
- Khan, R. (2021, Mar. 8). Social media fueled stock market trading: The unsuspecting need to be protected. *Forbes*. <https://www.forbes.com/sites/roomykhan/2021/03/08/social-media-fueled-stock-market-trading-the-unsuspecting-need-to-be-protected/?sh=20cdf39f27dd>
- Kritikos, A., Handrich, L., Gorgels, S., Priem, M., & Morales, O. (2022). *Hype or New Normal? Insights into the motives and behavior of a new generation of investors* (Study report). DIW Econ. https://diw-econ.de/wp-content/uploads/DIW_Econ_Hype_or_New_Normal_Generation_of_Investors_v1.0_FINAL.pdf
- Laurent, L. (2021, Jun. 10). The FOMO Economy: Is everyone making money but you? *Businessweek Finance*. <https://www.bloomberg.com/news/articles/2021-06-10/is-everyone-making-money-but-you-the-fomo-economy-of-memes-crypto-housing>
- Linehan, C., Kirman, B., & Roche, B. (2015). Gamification as behavioral psychology. In S. P. Walz & S. Deterding (Eds.), *The gameful world: Approaches, issues, applications* (pp. 81-105). MIT Press.
- Looyestyn, J., Kernot, J., Boshoff, K., Ryan, J., Edney, S., & Maher, C. (2017). Does gamification increase engagement with online programs? A systematic review. *PloS one*, 12(3). <https://doi.org/10.1371/journal.pone.0173403>
- Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1), 77-91.
- McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. Penguin.
- Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, 71, 525-534. <https://doi.org/10.1016/j.chb.2015.08.048>
- Merli, M., & Roger, T. (2013). What drives the herding behavior of individual investors? *Finance*, 34(3), 67-104. <https://doi.org/10.3917/fina.343.0067>
- Mesly, O., & Racicot, F.-E. (2017). A stylized model of home buyers' and bankers' behaviours during the 2007-2009 US subprime mortgage crisis: A predatory perspective. *Applied Economics*, 49(9), 915-928. <https://doi.org/10.1080/00036846.2016.1208358>

- Meyer, S., Uhr, C., & Johanning, L. (2021). *Private investors and the emergence of neo-brokers: Does payment for order flow harm private investors?* (Study report). Trade Republic. https://assets.traderepublic.com/assets/files/202111_study_private_investors_and_the_emergence_of_neo_brokers.pdf
- Nagy, R. A., & Obenberger, R. W. (1994). Factors influencing individual investor behavior. *Financial Analysts Journal*, 50(4), 63-68.
- Odean, T. (1998). Are investors reluctant to realize their losses? *Journal of Finance* 53(5), 1775-1798.
- Odean, T. (1999). Do investors trade too much? *The American Economic Review*, 89(5), 1279-98.
- Oliver, J. (2021, Oct. 1). Inside the battle to be Europe's Robinhood. *Financial Times*. <https://www.ft.com/content/d3cbfa1f-d712-46b6-8595-ebc36b6c7162>
- Oyster, M. J. (2018). *Success in a Low-Return World: Using Risk Management and Behavioral Finance to Achieve Market Outperformance*. Palgrave Macmillan. https://doi.org/10.1007/978-3-319-99855-8_6
- Pal, A., Indapurkar, K., & Gupta, K. P. (2021). Gamification of financial applications and financial behavior of young investors. *Young Consumers*, 22(3), 503-519. <https://doi.org/10.1108/YC-10-2020-1240>
- Phan, D. T. T., Le, V. H. T., & Nguyen, T. T. H. (2020). Overconfidence bias, comparative evidences between Vietnam and selected ASEAN countries. *The Journal of Asian Finance, Economics and Business*, 7(3), 101-113. <https://doi.org/10.13106/jafeb.2020.vol7.no3.101>
- Pompian, M. M. (2006). *Behavioral finance and wealth management: How to build optimal portfolios that account for investor biases*. John Wiley & Sons.
- Potsaid, T., & Venkataraman, S. (2022). Trading restrictions and investor reaction to non-gains, non-losses, and the fear of missing out: Experimental evidence. *Journal of Behavioral and Experimental Finance*, 33, 100597. <https://doi.org/10.1016/j.jbef.2021.100597>
- Prechter, R. R. (2001). Unconscious Herding Behaviour as the Psychological Basis of Financial Market Trends and Patterns. *The Journal of Psychology and Financial Markets*, 2(3), 120-125. https://doi.org/10.1207/S15327760JPFM0203_1
- Prosad, J. M., Kapoor, S., & Sengupta, J. (2015). Behavioral biases of Indian investors: A survey of Delhi-NCR region. *Qualitative research in financial markets*, 7(3), 230-263. <https://doi.org/10.1108/QRFM-04-2014-0012>
- Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. *Computers in Human Behavior*, 29(4), 1841-1848. <https://doi.org/10.1016/j.chb.2013.02.014>
- Purohit, H., & Srivastava, S. (2011). *Irrational behaviour of investors: Evidences from international literature review*. SSRN Electronic Journal. <http://dx.doi.org/10.2139/ssrn.3734455>
- PWC (2020). *Gen Z is talking. Are you listening? # 3 of PWC Europe Consumer Insight Series*. PWC. <https://www.pwc.de/de/handel-und-konsumguter/gen-z-is-talking-are-you-listening.pdf>
- Rakesh, H. M. (2013). Gambler's fallacy and behavioral finance in the financial markets: A case study of Bombay stock exchange. *International Journal of Business and Management Innovation*, 2(12), 1-7. [https://www.ijbmi.org/v2i12\(version1\).html](https://www.ijbmi.org/v2i12(version1).html)
- Rasool, N., & Ullah, S. (2020). Financial literacy and behavioural biases of individual investors: Empirical evidence of Pakistan stock exchange. *Journal of Economics, Finance and Administrative Science*, 25(50), 261-278. <https://doi.org/10.1108/JEFAS-03-2019-0031>
- Robinhood (2022a). *Robinhood Financial Fee Schedule*. Robinhood. https://cdn.robinhood.com/assets/robinhood/legal/RHF_Fee_Schedule.pdf
- Robinhood (2022b, Jan. 27). *Robinhood Reports Fourth Quarter and Full Year 2021 Results*. Robinhood. <https://investors.robinhood.com/news/news-details/2022/Robinhood-Reports-Fourth-Quarter-and-Full-Year-2021-Results/default.aspx>
- Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I., & Pitt, L. (2015). Is it all a game? Understanding the principles of gamification. *Business Horizons*, 58(4), 411-420. <https://doi.org/10.1016/j.bushor.2015.03.006>
- Rodrigues, L. F., Oliveira, A., & Costa, C. J. (2016). Does ease-of-use contributes to the perception of

- enjoyment? A case of gamification in e-banking. *Computers in Human Behavior*, 61, 114-126. <https://doi.org/10.1016/j.chb.2016.03.015>
- Russo, J. E., & Schoemaker, P. J. (1992). *Managing overconfidence*. *Sloan Management Review*, 33(2), 7-17.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68-78. <https://psycnet.apa.org/doi/10.1037/0003-066X.55.1.68>
- Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, 69, 371-380. <https://doi.org/10.1016/j.chb.2016.12.033>
- Salen, K. & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. MIT Press.
- Schell, J. (2008). *The art of game design: A book of lenses*. CRC Press.
- Shefrin, H., & Statman, M. (1985). The Disposition to sell winners too early and ride losers too long: Theory and evidence. *The Journal of Finance*, 40(3), 777-790.
- Shiva, A., Narula, S., & Shahi, S. K. (2020). What drives retail investors' investment decisions? Evidence from no mobile phone phobia (nomophobia) and investor fear of missing out (I-FOMO). *Journal of Content, Community and Communication*, 10(6), 2-20. <https://doi.org/10.31620/jccc.06.20/02>
- Shrikanth, S. (2020). 'Gamified' investing leaves millennials playing with fire. *Financial Times*. <https://www.ft.com/content/9336fd0f-2bf4-4842-995d-0bcbab27d97a>
- Shukla, A., Rushdi, N. J., & Katiyar, R. C. (2020). Impact of behavioral biases on investment decisions 'a systematic review'. *International Journal of Management*, 11(4), 68-76. https://iaeme.com/MasterAdmin/Journal_uploads/IJM/VOLUME_11_ISSUE_4/IJM_11_04_009.pdf
- Statista (2022). Neobrokers - Germany. <https://www.statista.com/outlook/dmo/fintech/digital-investment/neobrokers/germany>
- Statman, M. (2014). Behavioral finance: Finance with normal people. *Borsa Istanbul Review*, 14(2), 65-73. <http://dx.doi.org/10.1016/j.bir.2014.03.001>
- Sundali, J., & Croson, R. (2006). Biases in casino betting: The hot hand and the gambler's fallacy. *Journal of Judgement and decision making*, 1(1), 1-12. <https://psycnet.apa.org/doi/10.1017/S1930297500000309>
- Thaler, R. (1999). The end of behavioral finance: why behavioral finance cannot be dismissed. *Financial Analysts Journal*, 55(6), 12-17.
- Thowfeek Ahamed, S., Athambawa, H., & Safeena. S. (2020). Irrational managers and firm performance - A mediating role of financing decisions. *Journal of Business Economics*, 2(2), 13-24. <http://ir.lib.seu.ac.lk/handle/123456789/5421>
- Trade Republic. (2022, Feb.). *Press Kit*. Trade Republic https://assets.traderepublic.com/assets/files/Trade_Republic_PressKit.pdf
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124-1131.
- Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, 5(4), 297-323.
- van der Heide, A., & Želinský, D. (2020). 'Level up your money game': An analysis of gamification discourse in financial services. *Journal of Cultural Economy*, 14(6), 711-731. <https://doi.org/10.1080/17530350.2021.1882537>
- von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton University Press.
- Zahera, S. A., & Bansal, R. (2018). Do investors exhibit behavioral biases in investment decision making? A systematic review, *Qualitative Research in Financial Markets*, 10(2), 210-251. <https://doi.org/10.1108/QRFM-04-2017-0028>
- Zaiane, S. (2015). Behavioral biases of individual investors: The effect of anchoring. *Eurasian Journal of Social Sciences*, 3(1), 13-19. <https://doi.org/10.15604/ejss.2015.03.01.002>

Contexts	Kinds of FOMO	Investment-related
FOMO, when others do not interact as expected	<ul style="list-style-type: none"> - Fear of missing the ability to be popular - (...) the ability to be interesting - (...) the ability to get the right interpretation 	<ul style="list-style-type: none"> o o o
FOMO, when unable to connect/interact as wished	<ul style="list-style-type: none"> - Fear of missing information due to large volume - (...) the ability to deal with different social networks - (...) temporally available information - (...) a timely interaction - (...) the ability to keep followers - (...) information/events due to multi following 	<ul style="list-style-type: none"> X X X X o X
FOMO, when unwilling to engage in social interactions	<ul style="list-style-type: none"> - Fear of missing valuable information - (...) the ability to defend your popularity 	<ul style="list-style-type: none"> X o
FOMO, when feeling a need to engage in untimed interactions	<ul style="list-style-type: none"> - Fear of missing empathy and leaving a good impression - (...) the opportunity to know others' impressions - Fear of losing popularity - Fear of missing a valuable opportunity - (...) the sense of relatedness - (...) spontaneous responses 	<ul style="list-style-type: none"> o o o X o o
FOMO, when expecting an online social gathering	<ul style="list-style-type: none"> - Fear of missing the opportunity to attend an online event - (...) the sense of relatedness - (...) the ability to be popular 	<ul style="list-style-type: none"> o o o

X = investment-related

Note. Adapted from Alutaybi et al. (2020: 3-4)

Table 1: Contexts and kinds of FOMO

No.	Item question (translated)	Association
1	I fear others have more rewarding experiences than me.	Original FOMO scale
2	I fear my friends have more rewarding experiences than me.	Original FOMO scale
3	I get worried when I find out my friends are having fun without me.	Original FOMO scale
4	It bothers me when I miss an opportunity to meet up with friends.	Original FOMO scale
5	When I miss out on a planned get-together it bothers me.	Original FOMO scale
6	I fear others make better investments in the stock market than me.	Investment-specific
7	I fear my friends make better investments in the stock market than me.	Investment-specific

Note. Adapted from Przybylski et al. (2013: 1847)

Table 2: FOMO scale items

	B	Beta	t-statistic	P	VIF
Constant	1.385		15.505	.000	
FOMO	.314	.376	11.048	.000	1.026
Trading experience	-.061	-.116	-3.394	.000	1.033
Trading frequency	.001	.105	3.120	.002	1.007
Gamification	b				
Age	b				
Gender	b				
R ²	.174				
VIF = Variance inflation factor; b. Excluded variables					

Table 3: Results of regression analysis

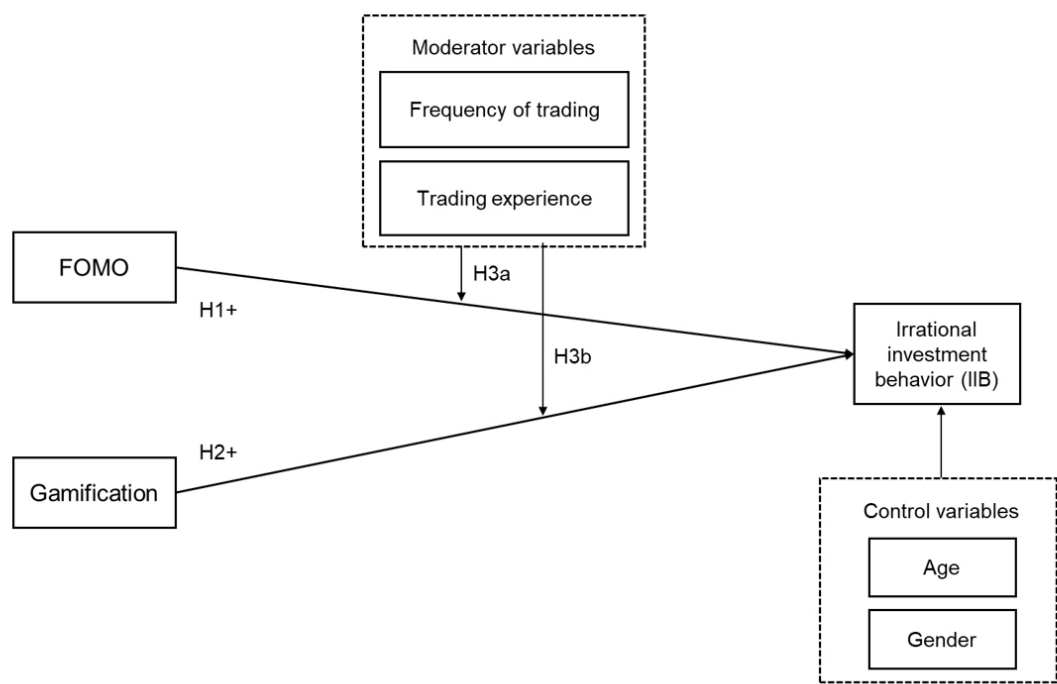


Figure 1: Conceptual Model