

Hype or New Normal? Insights into the motives and behavior of a new generation of investors

Long-term study

February 9th, 2022

Authors:

Prof. Dr. Alexander Kritikos is DIW Econ Senior Research Associate, Member of the Executive Board and Research Director at DIW Berlin and Professor of Industrial and Institutional Economics at the University of Potsdam.

Dr. Lars Handrich is managing director at DIW Econ.

Dr. Stefan Gorgels is consultant at DIW Econ.

Maximilian Priem is senior data scientist at DIW Econ.

Octavio Morales is analyst at DIW Econ.

The study was commissioned by Trade Republic.

DIW Econ GmbH

Dr. Stefan Gorgels

Mohrenstraße 58

10117 Berlin

Tel. +49.30.20 60 972 - 20

Fax +49.30.20 60 972 - 99

sgorgels@diw-econ.de

www.diw-econ.de

Contents

| | |
|--|-----------|
| Executive Summary | 1 |
| 1. Introduction | 4 |
| 2. Data | 5 |
| 3. Who uses neobrokers? | 6 |
| 3.1 Socio-demographic analysis | 6 |
| 3.2 A new generation of investors in focus | 10 |
| 4. Motives of users | 15 |
| 4.1 Analysis of investment personalities | 17 |
| 4.1.1 Factor analysis - What are the basic motives and principles? | 17 |
| 4.1.2 Cluster analysis - Which investment personalities exist? | 19 |
| 5. Investment behavior of users | 25 |
| 5.1 Portfolio structure | 25 |
| 5.2 Value at risk | 28 |
| 5.3 Annualized return | 31 |
| 6. Discussion | 33 |
| 7. Conclusion | 36 |
| 8. Bibliography | 37 |

Executive Summary

This study is based on the survey results of 216,000 users of the neobroker Trade Republic and as such represents the world's largest survey-based study on the socio-demographic background, investment behavior and motives of private investors ever conducted¹. The key findings are summarized below:

1. A new generation of investors

While a broad range of user groups uses neobrokers such as Trade Republic, users of neobrokers are predominantly young and first-time investors:

- Almost 70% of users are younger than 35 years.
- Almost half of users are novice investors who are investing in capital markets for the first time.
- Novice investors have on average invested 37% of their total private wealth in the capital market.
- This new generation of young investors spans across all income levels as almost 30% of novice investors belong to the lower half of the income distribution.

2. Most investors invest for the long run

Contrary to concerns that neobroker investors are thrill-seekers aiming for short-term profit maximization, the vast majority of neobroker users want to invest for the long-term:

- 72% of users invest to make a long-term contribution to their retirement plan.
- 77% of users invest because there is no other lucrative alternative to save.
- Only 34% of users attach great importance to short-term gains and merely 20% state that they primarily enjoy the thrill of investing

¹ While 250,000 users participated in the original survey, this study includes data on approximately 216,000 Trade Republic users who executed at least one trade and had a minimum of EUR 100 in assets in their accounts as of April 1, 2021. This restriction allows for a representative dataset and an unbiased interpretation of the characteristics and behaviors of users.

3. The actual investment behavior is in line with long-term investment motives

The survey data is compared to the respondents' trading data to investigate the extent to which motives and risk preferences expressed in the survey correspond with the actual investment behaviors of users. This link is methodologically important as the response behavior to surveys is always subject to possible biases due to the "social desirability" of certain answers. It is conceivable, for example, that respondents indicate that they are motivated to invest for the long term as they anticipate that this is the socially desired response.

An analysis of users' portfolios leads to the following results:

- Almost 60% of capital assets are invested in stocks and 26% in ETFs.
- Derivatives, which are significantly riskier than equities and ETFs due to leverage effects, account for only 2% of the portfolios. The remaining 12% is held in cash.
- Compared to experienced investors, novice investors invest a smaller share of their portfolios in stocks (56% vs. 63%) and derivatives (1.2% vs. 2.6%), and a significantly larger share in ETFs (31% vs. 22%). Contrary to concerns that young, inexperienced investors are induced by neobrokers to invest in particularly risky financial products, novice investors predominantly invest in diversified and less risky products such as ETFs. In addition to the observed user behavior, this is also supported by the fact that novice investors state that they are less willing to take on increased risk for higher returns vs. more experienced investors.
- Finally, investors who describe themselves as more risk-averse tend to invest in less risky products such as ETFs and, consequently, have portfolios with a lower risk (i.e., measured by value at risk).

The actual investment behavior is thus in line with investment motives and risk preferences expressed in the survey. This indicates, first, that users are indeed motivated to invest for the long run, and second, that users have the necessary financial literacy to invest according to their motives and preferences.

4. The average return increases with the length of the investment period

It is important to note that most users have been investing with Trade Republic for less than a year, meaning that realized returns primarily depend on overall market developments during the same time frame.

- The median annual return for all users is 7.1%. For users who have been investing for at least 12 months, the median annual return is 11.1%².
- While 63% of all users have achieved a positive return, this figure rises to 83% for users who have been investing for at least 12 months.
- Long-term oriented investors have realized higher annualized returns than investors who are focused on short-term gains (median annualized returns of 8.7% vs. 2.0%)

² For users who have been investing for less than one year, the annual return is calculated by extrapolating the return achieved over the shorter period to one year.

1. Introduction

A growing number of people has recently started using neobrokers to invest in capital markets. Neobrokers have successfully established themselves in the world of banks and brokers by making it easier for investors to open accounts and invest as well as by lowering costs³. The rapid growth of neobroker users, especially among young people, could make an important contribution to long-term wealth accumulation and retirement planning. At the same time, there is concern regarding the "gamification of investing", i.e., the fear that the ease of use of investment apps, coupled with low costs, could prompt users to engage in fast, risky trading. This study investigates the socio-demographic background, motives, and investment behavior of users of the neobroker Trade Republic. The study is based on a unique dataset collected by surveying 250,000 Trade Republic users. This is the largest survey study on the motives and behaviors of private investors ever conducted. It should be noted that the survey data, and therefore the results of this study, are not necessarily representative of all neobrokers as Trade Republic, unlike other neobrokers, does not offer certain, particularly risky, products, such as contracts for difference.⁴

The four key findings of this study can be summarized as followed:

- While a broad range of users invests through neobrokers such as Trade Republic, neobroker users are predominantly young and often novice investors
- Most users want to invest for the long term and have their portfolios to contribute to their retirement provision
- Novice investors predominantly invest in diversified and thereby less risky products such as ETFs
- The average return that users realize increases with the length of the investment period

³ In the survey of Trade Republic users, 71.1% of users said that they particularly like the low cost.

⁴ In the following analysis, the terms "neobroker" and "neobroker generation" thus refer predominantly to Trade Republic or those neobrokers that offer similar products.

2. Data

The study is based on a unique dataset on the motivation and characteristics of neobroker users, which were collected in a survey among Trade Republic users. More than 250,000 users completed the questionnaire, which was sent out via e-mail, within 14 days. The questionnaire comprises a total of 28 questions on the following subject areas:

- Socio-demographic background
- Capital market investment experience
- Distribution of assets
- Motives for investing, risk preferences, and financial literacy

The survey results were linked with the users' anonymized investment data and behaviors. This study, thus, includes representative data on approximately 216,000 Trade Republic users who executed at least one trade and had a minimum of EUR 100 in assets in their accounts as of April 1, 2021. Without these restrictions, it would not be possible to infer representative statements as users with assets of less than EUR 100 were underrepresented in the survey results.

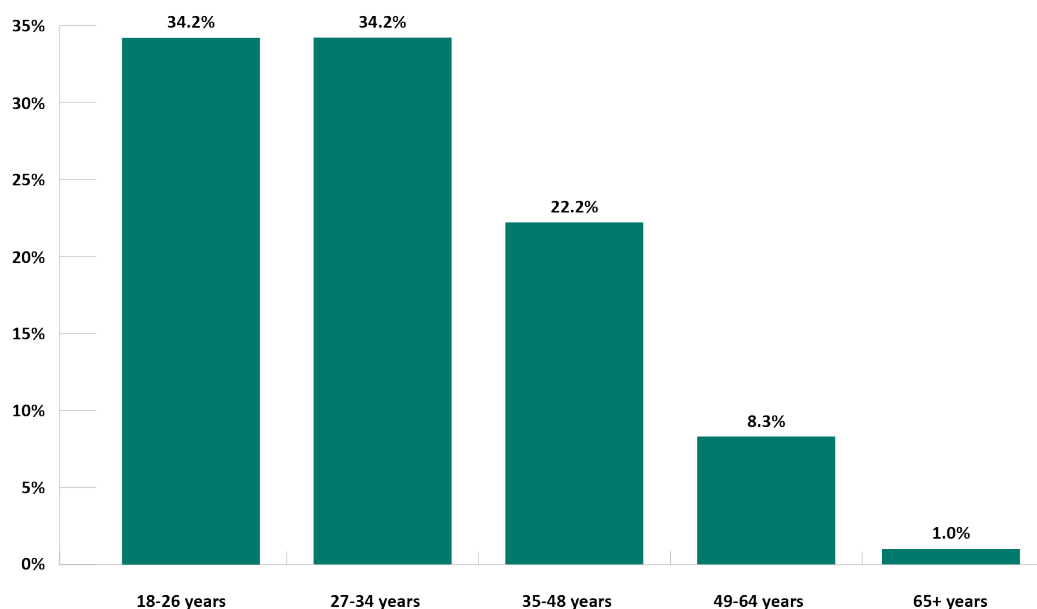
3. Who uses neobrokers?

3.1 Socio-demographic analysis

Users are grouped based on three main socio-demographic variables to better differentiate them: age, gender, and income. In addition, users' risk preferences are collected and compared to the average risk preference of the German population as a whole.

Age: All age groups are represented among the users. However, young people represent the vast majority. Almost 70% of users are under 35 and more than 34% are between 18 and 26 years old.⁵

Figure 3-1: Users by age group



Source: Survey (2021), N = 216,224, users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade.

Gender: The large majority (84.3%) of users are male, 15.3% are female and 0.5% are diverse⁶. Such differences in gender with respect to participation in capital markets are not a phenomenon specific

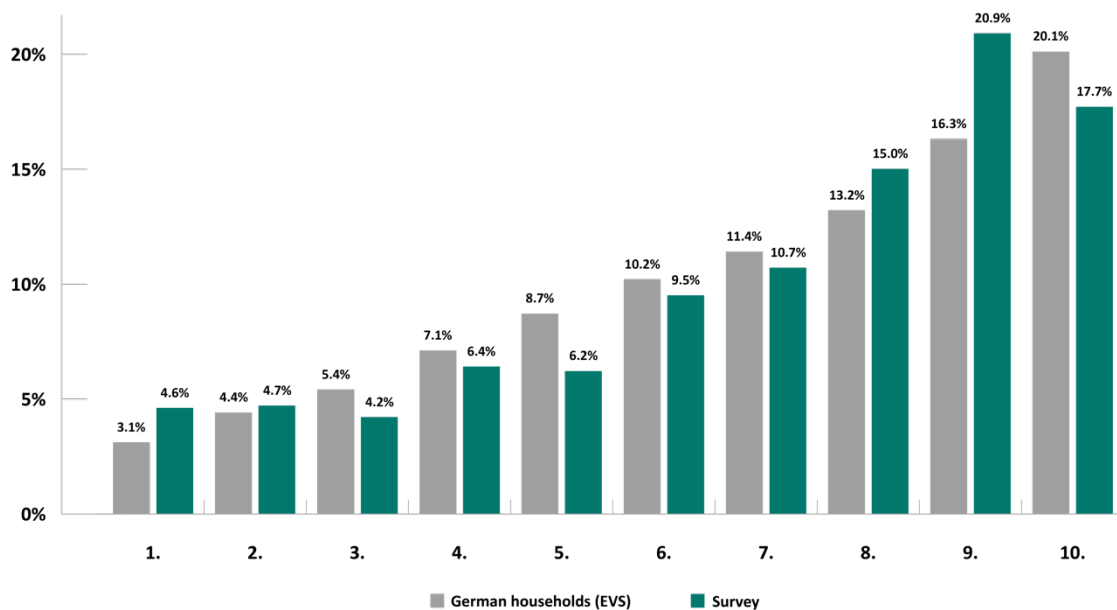
⁵ The life phases are based on the social science concept of four life stages: childhood and youth, education phase, employment phase and retirement. Similar to the analyses of the Poverty and Wealth Report of the Federal Government (BMAS, 2021), the phase "childhood and adolescence" is not taken into account here and the employment phase is divided into an early, middle and later phase.

⁶ Gender here refers to gender identity, which was recorded in the survey by allowing respondents to complete the sentence "I am..." with "female," "male," or "diverse".

to neobrokers, but rather an expression of general gender inequality in capital market participation. According to Deutsches Aktieninstitut (2021), only 36.3% of Germans who invest in shares, funds or ETFs are women. The study also shows that women invest more often in funds than in stocks.

Income: All income groups are represented. At the same time, Figure 3-2 shows that higher income groups are relatively overrepresented. 75% of users belong to the upper half of the German income distribution, 25% to the lower half. To further classify the results, Figure 3-2 compares the income distribution of Trade Republic users with those of German households with capital market assets based on data from the “Einkommens- und Verbrauchersstichprobe” (EVS) from 2018. In general, the survey data and EVS paint a similar picture; households who invest in capital markets are disproportionately more likely to rank among higher income deciles.⁷

Figure 3-2: Distributions of users and German households with capital market assets across income deciles

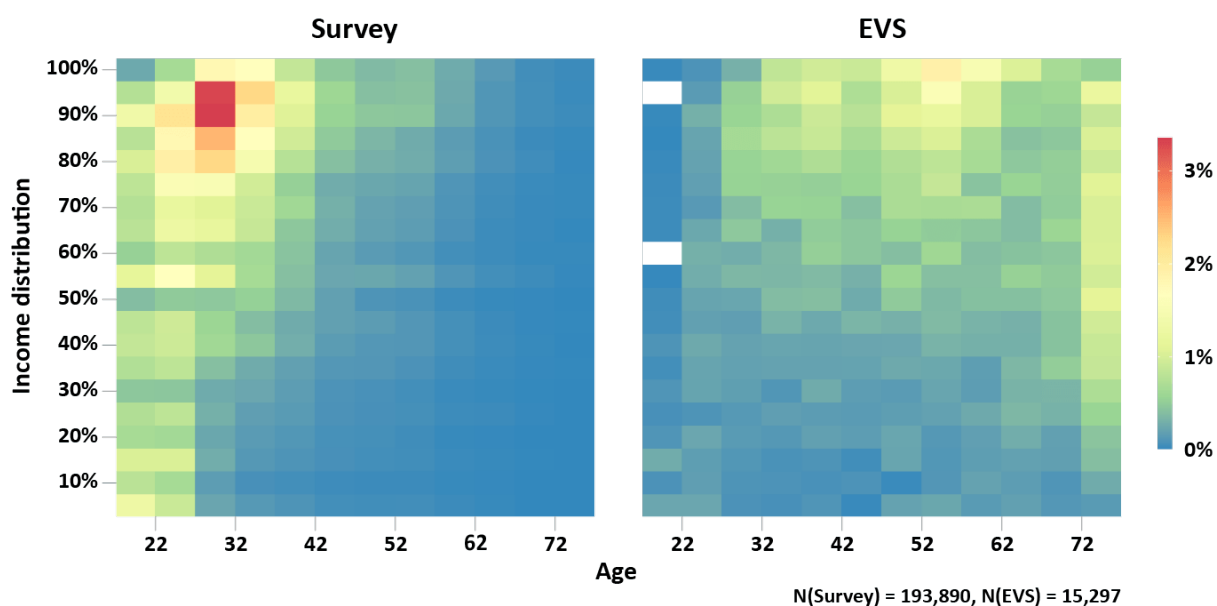


Source: Survey (2021), N = 193,890, users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade. EVS (2018), N = 15,062. Decile boundaries of the distribution of net equivalent household income were calculated based on the socio-economic panel (wave 36) and adjusted for inflation.

⁷ The higher share of Trade Republic users in the 9th income decile can likely be explained by the fact that the survey had an upper limit for net household incomes of EUR 8,000, which can lead to particularly high household incomes (with several household members), which actually lie in the 10th income decile, slipping into the 9th decile.

Age and income: Figure 3-3 illustrates again the differences in age and income between neobroker users and German households with capital assets based on the EVS. The coloring of the heat maps indicates the share of people in a respective income and age combination relative to the total number of people surveyed. There is a strong concentration on young age groups under 40 (yellow-green coloring on the left) among neobroker users. **At the same time, young neobroker users span across all income levels** (the yellow-green coloration extends across the entire vertical axis of the income distribution, which indicates a higher concentration of users). In contrast, the EVS data on German households with capital assets is heavily concentrated on older age groups. In addition, EVS respondents in younger age groups predominantly rank in higher income groups. These observations support the thesis that neobrokers enable young people in particular across all income levels to participate in capital markets.

Figure 3-3: Income and age distribution of users and German population

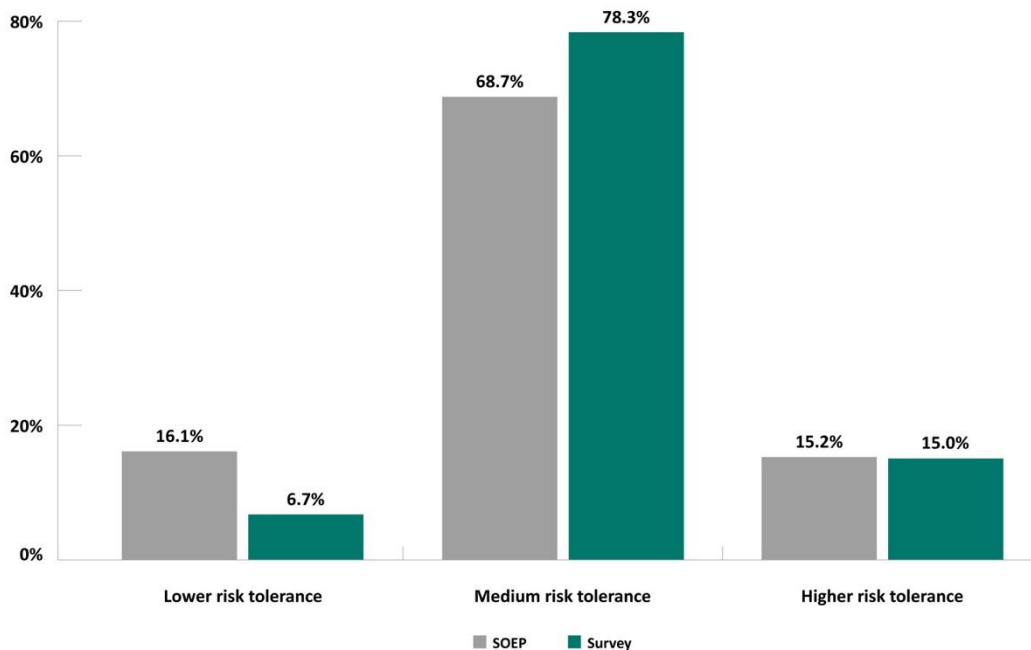


Source: Survey (2021), N = 193,890, users with assets of at least EUR 100 as of April 1, 2021 who have actively executed at least one trade. EVS (2018), N = 15,062. Decile boundaries of the distribution of net equivalent household income were calculated based on the socio-economic panel (wave 36) and adjusted for inflation.

Risk tolerance: Another relevant demographic variable, especially regarding capital market behavior, is the risk tolerance of the surveyed users. Figure 3-4 compares the risk tolerance of surveyed users with those of the German population. The data on the German population is based on the Socio-

Economic Panel (SOEP).⁸ In general, the distribution of risk tolerance of surveyed users is similar to those of the German population as a whole. Most users report a medium risk tolerance, while only 15% of users report a higher risk tolerance. However, it is noticeable that the share of risk-averse users (i.e., a low risk tolerance) is significantly lower among surveyed users (7%) than the German average (16%). It seems reasonable to conclude that the share of risk-averse users is lower in the survey because the share of both young and male users is higher compared to the whole German population (Chauvin, Hermand, & Mullet, 2007; Rosen, Tsai, & Downs, 2003; Wiedemann & Mertens, 2005). However, this difference in risk preferences remains when exclusively comparing risk preferences of young males from the survey and the SOEP. Hence, the difference seems to arise from the fact that risk-averse people are generally less likely to invest in capital markets and use new neobrokers to invest their money in the first place (Barasinskar, Schaefer, & Stephan, 2012).

Figure 3-4: Summary of risk tolerance of users and the general population



Source: Survey (2021), N = 216,224, users with assets of at least EUR 100 as of April 1, 2021 who have actively executed at least one trade.

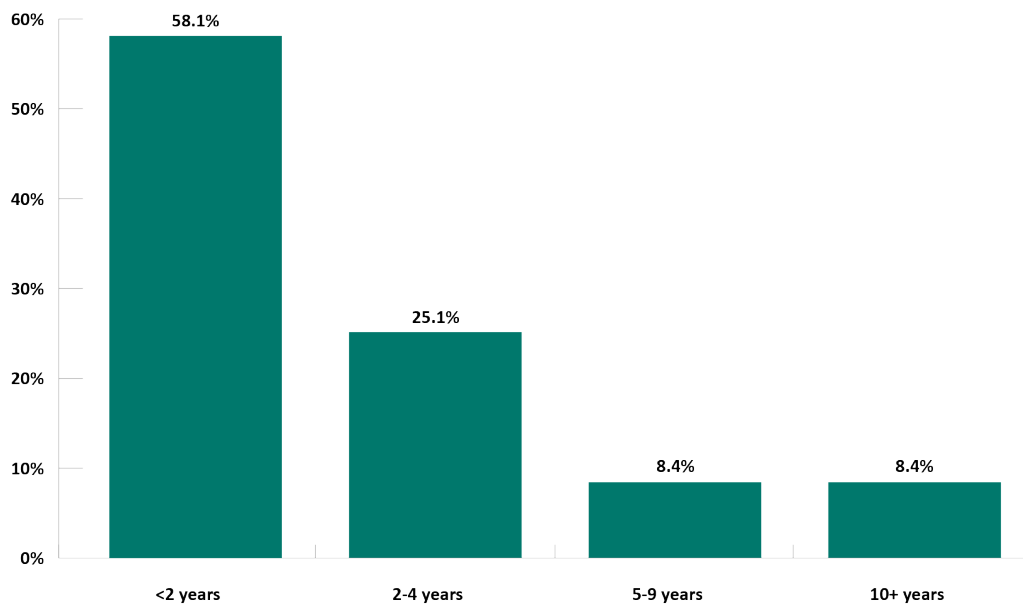
⁸ The survey question on risk attitude was phrased the same way as in the corresponding question in the SOEP. "How do you personally rate yourself? Are you generally a risk-taker, or do you try to avoid risk? Please answer using the following scale, where a value of 0 means: not at all willing to take risks and a value of 10 means: very willing to take risks. The answers were then summarized as follows. The "low risk tolerance" category includes answers from 0-2, "medium risk tolerance" includes answers from 3-7, and "higher risk tolerance" includes answers from 8-10.

3.2 A new generation of investors in focus

As the socio-demographic analysis shows that the majority of neobroker users are young, the question arises whether these users can indeed be considered a new generation of investors.

Experience with capital markets: The majority of neobroker users have limited experience with capital markets: 58% of the surveyed users state that they have less than two years of experience investing in capital markets. This is in line with the age structure of surveyed users and can be seen as the first indication of a new generation of investors.

Figure 3-5: Experience with capital market investments in years



Source: Survey (2021), N = 215,154, users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade.

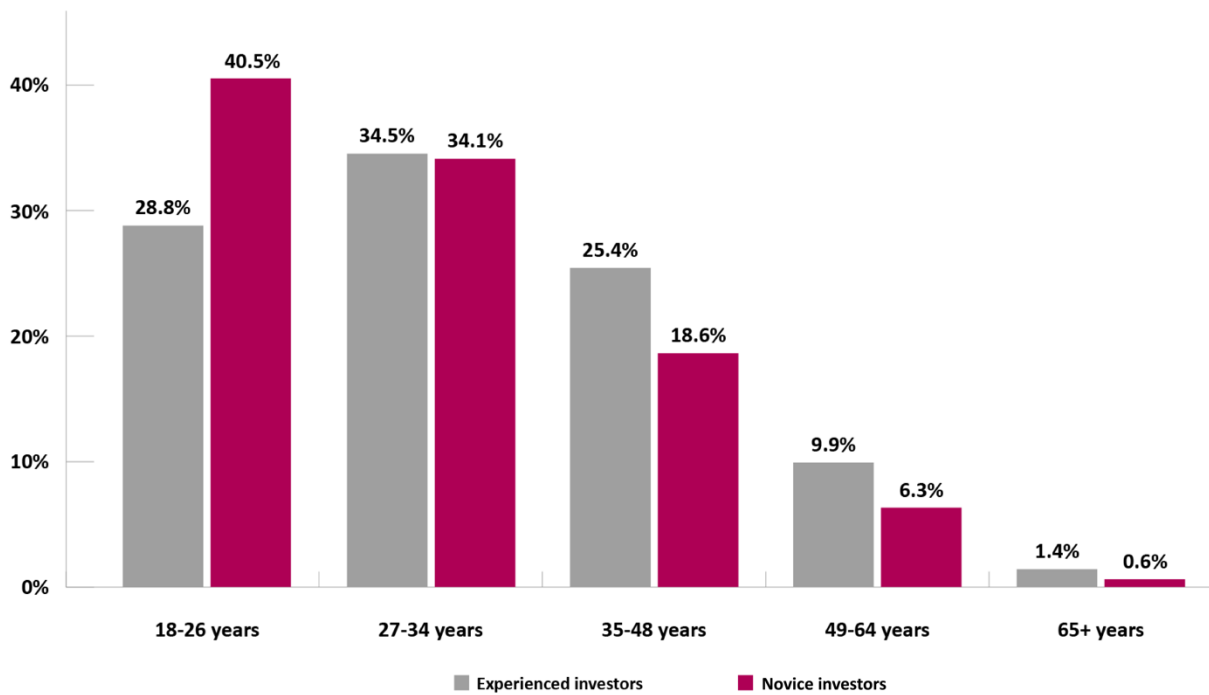
To further investigate the extent to which a new generation of investors participates in capital markets for the first time through neobrokers like Trade Republic, users were asked about the distribution of their assets across different investment categories (capital market, real estate, checking account, etc.). Respondents were asked about the split of their assets prior to using Trade Republic as well as at the date of the survey:

- 47% of the users surveyed had not invested at all in capital markets before using Trade Republic. This group of users is henceforth referred to as novice investors.
- These novice investors have on average invested 37% of their total assets in capital markets since starting using Trade Republic.

The following section distinguishes socio-demographic variables such as age, income, and gender between novice and experienced investors.

Age: Novice investors are younger than experienced users who had already invested in capital markets. For the age group 18 to 26, the share of novice investors is significantly higher (41%) than the share of experienced investors (29%).

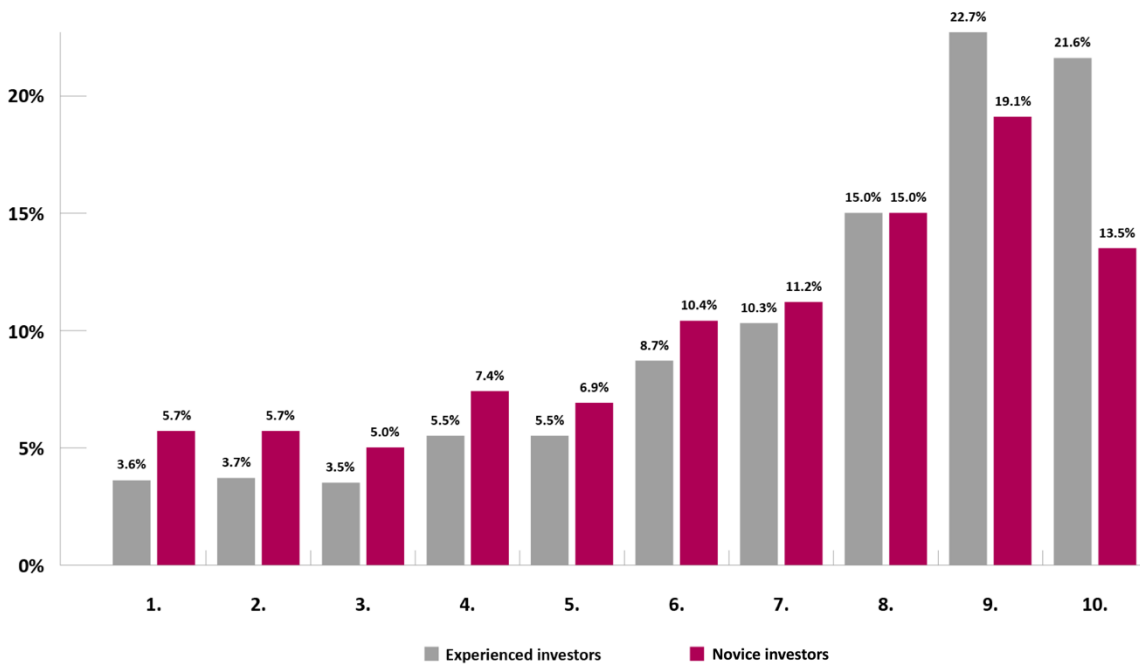
Figure 3-6: Age groups of users by level of experience



Source: Survey (2021), N = 216,224, users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade.

Income: Users who invest in capital markets for the first time are more likely to have lower incomes than experienced users. 28% of novice investors belong to the lower half of the income distribution compared to only 20% of experienced investors. Moreover, novice investors are significantly more likely to belong to the lowest two income deciles than German households with capital assets as recorded in the EVS. 5.7% of the surveyed novice investors belong to the lowest and second lowest income deciles respectively, compared to only 3.1% and 4.4% for the EVS household data.

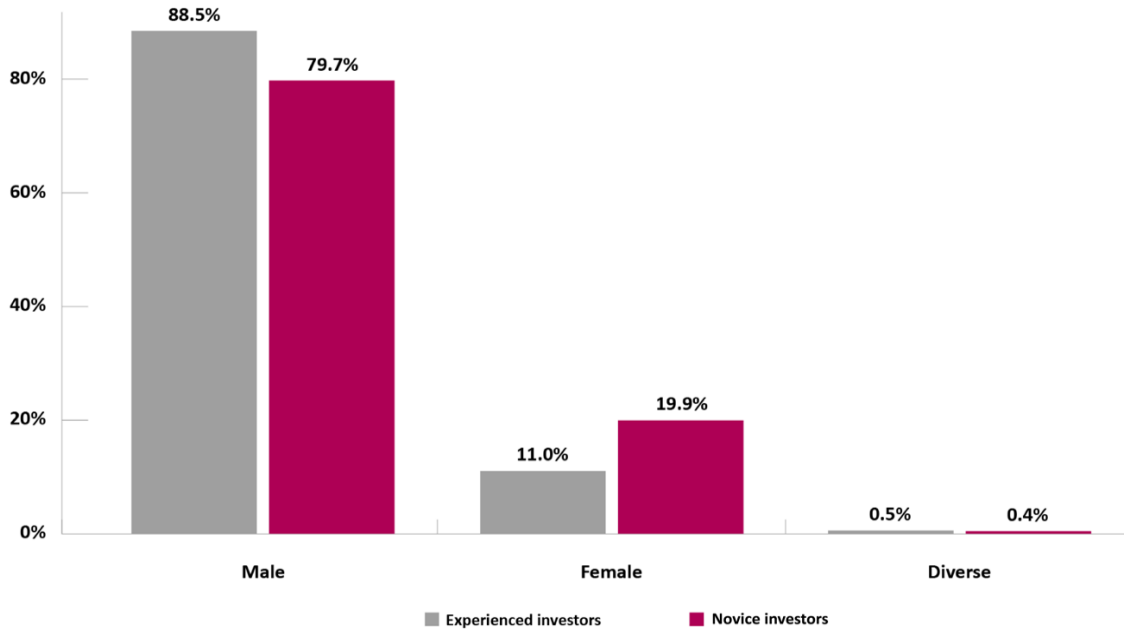
Figure 3-7: Income deciles of users by level of experience



Source: Survey (2021), N = 193,890, including users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade. Equivalence-weighted net household income.

Gender: Compared to experienced investors, the new generation of investors is significantly more female. The share of women among novice investors equals 20%, which is almost twice as high as the share of women among experienced investors (11%).

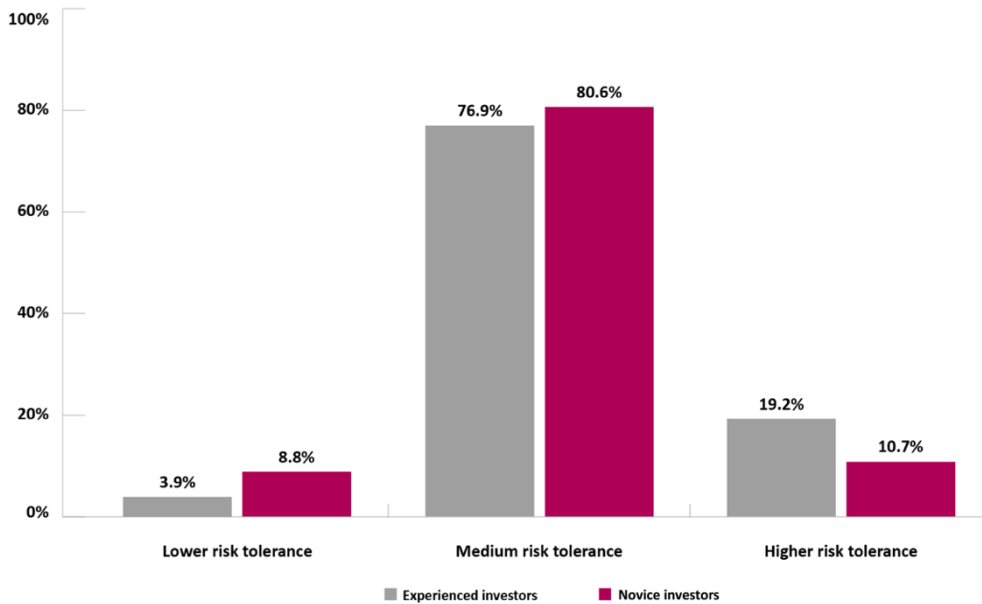
Figure 3-8: Gender of users by level of experience



Source: Survey (2021), N = 215.594, users with assets of at least EUR 100 as of April 1, 2021, who have executed at least one trade.

Risk Tolerance: The new generation of investors is characterized by a lower risk tolerance compared to experienced investors. In fact, the share of investors with a higher risk tolerance is almost twice as high among experienced investors (19%) as among novice investors (11%).

Figure 3-9: Risk Tolerance of the users by level of experience



Source: Survey (2021), N = 215.594, users with assets of at least EUR 100 as of April 1, 2021 who have actively executed at least one trade.

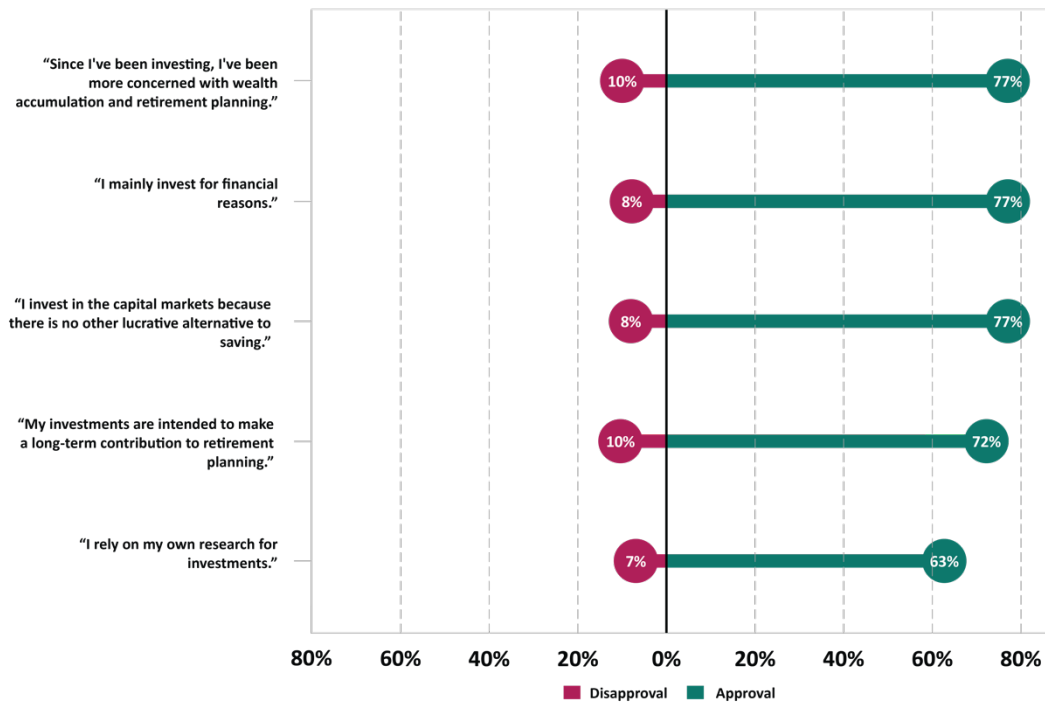
It can be concluded that neobrokers make access to capital markets more inclusive as a younger and less affluent part of the population is empowered to invest through easier access and lower costs.

4. Motives of users

As a new generation of investors enters the capital markets via neobrokers, the question naturally arises, what is this new generation driven by? What especially motivates young investors who invest for the first time? Media reports often focus on “gamification of investing,” the fear that the ease of use of investment apps, coupled with low costs, could prompt users to engage in fast, risky trading. This contrasts with the potential benefits neobrokers could enable, e.g., long-term wealth-building.

To assess how relevant “gaming” behavior among neobroker users truly is, users’ short- and long-term investment motives were surveyed. Figure 4-1 shows the five statements with the highest approval and disapproval ratings.

Figure 4-1: Top 5 agreements with statements on investment motivation



Source: Survey (2021), N = 216,223, users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade. Response options: [1] "Does not apply at all", [2] "Rather does not apply", [3] "Partly/partly", [4] "Rather applies", [5] "Fully applies". [1] & [2] = disagree, [4] & [5] = agree.

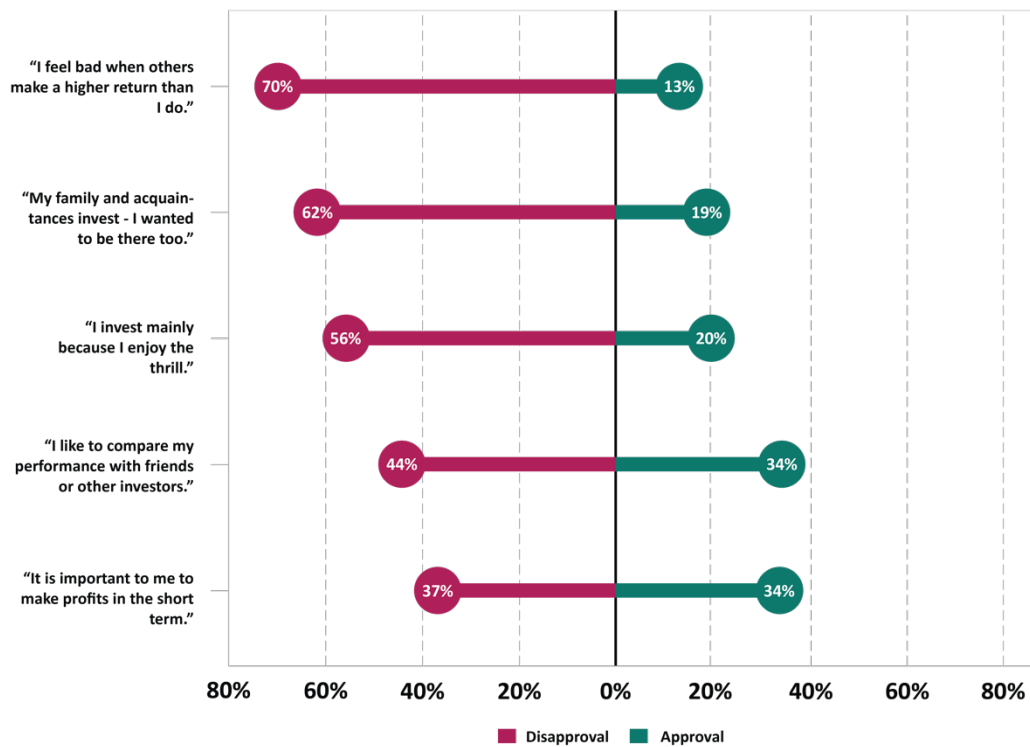
Most users agree with statements that indicate long-term, rational investment behavior.

- 77% of users state that they invest in the capital market given the lack of lucrative alternatives.
- 72% of users want their investments to make a long-term contribution to their retirement provision.

The results further show that users mainly rely on their own research when making investment decisions.

The lowest approval ratings were recorded for statements that indicate emotional or social investment motives and short-term investment horizons as shown in Figure 4-2.

Figure 4-2: Top 5 disagreements with statements on investment motivation



Source: Survey (2021), N = 216,223, users with assets of at least EUR 100 as of April 1, 2021, who have actively executed at least one trade. Response options: [1] "Does not apply at all", [2] "Rather does not apply", [3] "Partly/partly", [4] "Rather applies", [5] "Fully applies". [1] & [2] = disagree, [4] & [5] = agree.

Only a small minority of users is motivated by short-term gains or thrill.

- 70% of users disagree with the statement that they feel bad when other investors achieve a higher return while only 13% agree with this statement.
- Only 20% of users invest primarily because they enjoy the thrill.
- 34% of users say that it is important for them to make short-term profits.

The results of the survey indicate that most users invest for the long term to contribute to their retirement provision.

4.1 Analysis of investment personalities

To understand the motivation of neobroker users in more detail, we conducted a factor and cluster analysis of motivation and investment behaviors.

This method allows for a systematic analysis of different "investment personalities". The focus remains on the question of who uses neobrokers to invest in capital markets and for what reasons. This analysis uncovered two key findings: First, neobrokers enable young people to access capital markets for the first time. Second, most of these young and novice investors are motivated to invest for the long term. Different motives will be more closely reviewed in the following analysis based on those findings.



4.1.1 Factor analysis - What are the basic motives and principles?

The first step to identify different types of investment personalities is a factor analysis. The basic idea when conducting a factor analysis is that the motives and investment principles of the surveyed users can be summarized with some basic, so-called "latent factors".⁹

Table 4-1 presents an overview of the identified factors and the statements that are positively or negatively associated with the respective factor. For example, the first factor "value-oriented investing" contains four items. The statement "It is important to me that my investments are in line with my values" is positively associated, as agreement (i.e., a higher value) with this statement increases the latent factor "Value-Oriented Investing." A high level of agreement with the statement "I only pay attention to the return of my investments," on the other hand, indicates that the factor "Value-Oriented Investing" is negatively associated for the respective respondent.

⁹ See appendix for a methodological explanation of exploratory factor analysis.

Table 4-1: Overview of latent factors and related statements

| Factor | Positively associated with the factor  | Negatively associated with the factor  |
|--|--|--|
| 1: Values-Oriented Investing (Values) | <ul style="list-style-type: none"> - It is important to me that my investments are in line with my values. - The (environmental) sustainability of my investments is important to me. - For the sustainability and social responsibility of my investments, I would be willing to accept a slightly lower return. | <ul style="list-style-type: none"> - I only pay attention to the return of my investments. |
| 2: Short-Term Thrill (Thrill) | <ul style="list-style-type: none"> - It is important to me to make short term profits. - I mainly invest because I enjoy the thrill. - I'm afraid of missing out on big price gains. - I feel bad when others achieve a higher return than I do. | |
| 3: Long-Term Investing (Long-Term) | <ul style="list-style-type: none"> - My investments are intended to make a long-term contribution to retirement planning. - I invest money for my family's future. - Since I started investing, I think more about wealth accumulation and retirement planning. - I mainly invest for financial reasons. | |
| 4: Autonomy (Autonomy) | <ul style="list-style-type: none"> - Investment decisions are so complex that one should seek the advice of experts when making them. - I rely mainly on recommendations from experts when making investment decisions. | <ul style="list-style-type: none"> - I rely on my own research for investments. |
| 5: Return-Oriented Investing (Return) | <ul style="list-style-type: none"> - I am willing to tolerate an increased risk to achieve higher returns. | <ul style="list-style-type: none"> - The security of my capital is more important to me than the return when investing. |

| | | |
|---|--|--|
| <p>6: Investing as a social phenomenon (Sociality)</p> | <ul style="list-style-type: none"> - I discuss financial investments with friends and family. - My family and acquaintances invest - I want to be part of that. - I like to compare my performance with that of friends or other investors. | |
|---|--|--|

4.1.2 Cluster analysis - Which investment personalities exist?

Based on the results of the factor analysis, the next step is to identify different investment personalities through a cluster analysis. The cluster analysis explores the extent to which certain underlying motives (represented by the factors) can be jointly identified in certain groups of investors ("clusters")¹⁰.

Table 4-2 provides an overview of the five identified clusters.¹¹ The spider's web graph illustrates the pronunciation of each of the five different factors. If the red dot is outside the grey-marked area, the factor is above average; if the red dot is inside the grey-marked area, the factor is below average. For instance, the cluster "Value-Oriented Long-Term Investing" is characterized by above-average factor values for "Return", "Autonomy" and "Long-Term" and "Values", while the factor "Thrill" is not very pronounced.

When interpreting the clusters, it should be considered that the values of the factors are defined relative to the average of all users. Therefore, it should always be kept in mind that users – as outlined above – tend to be motivated by long term considerations on average. Hence, a high factor score for "Long-Term" means that the cluster "Value-Oriented Long-Term Investing" shows a particularly strong preference for long-term investing which goes even beyond the already high average score. In addition to the "Value-Oriented Long-Term Investing" cluster, a second cluster can be identified which places particular emphasis on return-oriented and long-term investing: the "Return-Oriented Long-Term Investing" cluster. The main difference between the two clusters is that the value-oriented cluster incorporates values such as sustainability into investment decisions in addition to returns, while the return-oriented cluster exclusively focuses on long-term returns. The "Classic Investing" cluster also has a slightly above-average long-term motive but differs from the other long-term motivated clusters

¹⁰ See appendix for a methodological explanation of the cluster analysis.

¹¹An additional 6th cluster was found, which, however, does not allow for a clear interpretation and can be interpreted as the "residual cluster" of all users (18.5%) who could not be classified in any other cluster.

in that users assign a lower score to the "Autonomy" factor. These investors rather rely on experts (e.g., bank advisors, financial influencers, etc.) instead of conducting their own research when making investment decisions. The cluster "Investing Securely Together" is characterized by two aspects. First, the users are very concerned about security. Second, they make their investment decisions in a social setting together with their friends or family. Finally, the "Short-Term Investing" cluster is the only one of the five clusters that is explicitly driven by short-term gains. The investors in this cluster have a particularly high score for the "Thrill" factor, and a particularly low score on the "Long-Term" factor.




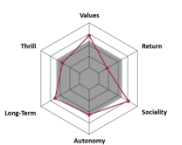
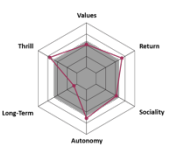
It is noticeable that three of the identified clusters, which account for 50% of all users, are above-average long-term motivated, while only one cluster, which accounts for 15% of all users, comprises users with clear short-term motivations.

Demographic background and investment behavior of the clusters

Table 4-2 presents key figures on the demographic background of the five clusters. Thereby clusters can be further differentiated based on their age, gender, and the share of novice investors. For instance, the "Investing Securely Together" cluster has an above-average share of novice investors (60%) as well as women (25%). Table 4-2 contains further information on the investment behavior of the clusters. It can be concluded that investment behavior is in line with the motives and investment principles expressed in the survey. Long-term oriented clusters have a significantly higher share of ETFs in their portfolios (between 28% and 34%) than the "Short-Term Investing" cluster (13%). These differences among clusters are also reflected in the average value at risk of the clusters' respective portfolios¹². The value at risk of long-term oriented clusters is significantly lower (3.2% to 3.7%) than the value at risk of the short-term oriented cluster (4.8%). Further, the long-term oriented clusters generate a higher annual return (7.1% to 8.8%) than the short-term oriented cluster (2%). A detailed analysis of the key figures for users' investment behavior follows in chapter 5. Lastly, the analysis shows that more than 6 out of 10 users who belong to clusters that are characterized by pronounced autonomy ("Return-Oriented Long-Term Investing" and "Value-Oriented Long-Term Investing") state that they spend at least one hour per week informing themselves about capital markets. Contrary, only 4 out of 10 respondents who belong to the cluster "classic investing", which has a lower factor score for "Autonomy", inform themselves about capital markets to the same extent.

¹² The value at risk measures the maximum loss that will not be exceeded with a certain probability in a certain period. In this case, it is the loss level that will not be exceeded in 95 % of all cases based on the 250 trading days prior to the survey period (March 31, 2021)

Table 4-2: Sociodemographics and investment behavior by cluster

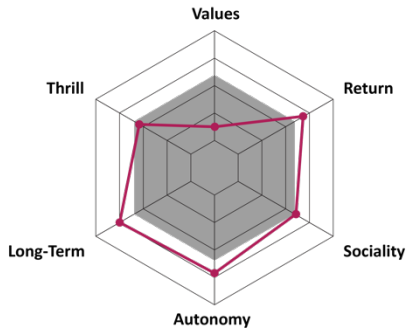
| | Total | Return-Oriented Long-Term Investing | Value-Oriented Long-Term Investing | Classic Investing | Investing Securely Together | Short-Term Investing |
|---|---------|---|--|---|---|---|
| | |  |  |  |  |  |
| Overall share | 100.0 % | 17.7% | 16.5% | 15.6% | 16.6% | 15.2% |
| Demographics | | | | | | |
| Percentage of women | 15.3% | 7.7% | 14.0% | 18.8% | 25.9% | 12.0% |
| Average age | 31.1 | 31.2 | 31,0 | 35.7 | 31,0 | 34.2 |
| Percentage of novice investors | 47.1% | 38.2% | 38.6% | 49.3% | 60.6% | 51.2% |
| Percentage of investors with children | 28.2% | 25.5% | 24.7% | 38.4% | 24.0% | 34.6% |
| Investment behaviour | | | | | | |
| Percentage ETFs | 26.1% | 26.1% | 28.1% | 33.7% | 37.1% | 12.7% |
| Percentage stocks | 59.7% | 59.6% | 58.6% | 52.4% | 49.2% | 71.2% |
| Percentage derivatives | 1.9% | 2.5% | 1.8% | 1.3% | 0.5% | 2.9% |
| Annualized Return (median) | 7.1% | 8.7% | 8.7% | 8.7% | 8.8% | 2.0% |
| VaR (mean) | 3.8% | 3.7% | 3.7% | 3.4% | 3.2% | 4.8% |
| Further information | | | | | | |
| Percentage that spends at least 60 min informing themselves about capital markets | 53.4% | 65.4% | 61.9% | 42.6% | 38.3% | 49.4% |

Note: The 5 clusters do not add up to 100% because of an additional 6th cluster, which, however, does not allow for a clear interpretation and can be interpreted as the "residual cluster" (18.5%).

Detailed description of the clusters

Cluster 1

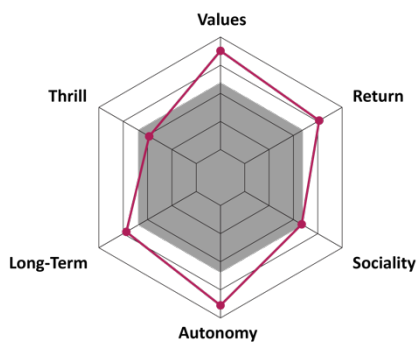
Return-Oriented Long-Term Investing



Users who belong to the "Return-Oriented Long-Term Investing" cluster are characterized by a long-term investment objective. In addition, they are willing to accept a higher risk in exchange for a higher return. They also differ from other clusters in that their investments are less guided by sustainability or value considerations. This cluster has a below-average share of women and a comparatively low share of novice investors.

Cluster 2

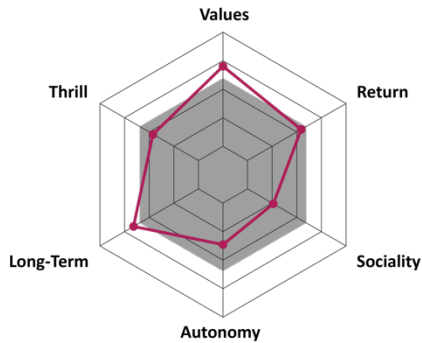
Value-Oriented Long-Term Investing



The users who belong to the "Value-Oriented Long-Term Investing" cluster are characterized by the fact that they invest in a value-oriented and sustainable manner and also take on slightly more risk for a higher return. Additionally, they primarily rely on their own research when making investment decisions. The cluster has a high share of academics and a low share of novice investors.

Cluster 3

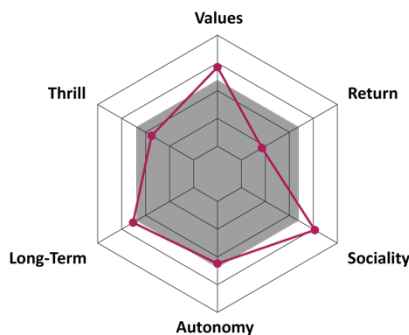
Classic Investing



The investment behavior of users in the "Classic Investing" cluster is characterized by a below average score for the "Autonomy" factor. These investors rely more often on experts when making investment decisions and less on their own research. Additionally, a low score for the "Sociality" factor indicates that these investors tend to see investing in capital markets as a private matter which they do not discuss with friends. This cluster thus corresponds to the "classic" image of private investors who seek advice from bank advisors and otherwise rather do not talk about their investments. This classification as "Classic Investing" behavior is further supported by the fact that these investors are the oldest when compared to investors across all other clusters. Finally, this cluster has the highest share of academics and the second-highest share of women.

Cluster 4

Investing Securely Together

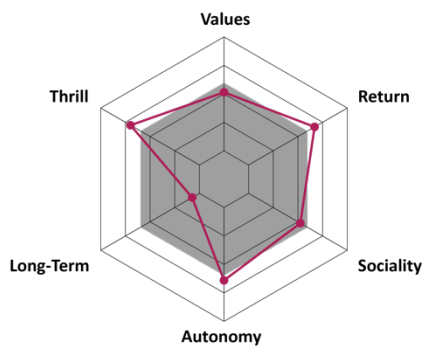


Users who belong to the "Investing Securely Together" cluster have a stronger preference for security than for returns. They invest in a value-oriented manner with little focus on short-term gains.

For these users, investing takes place in a social context with friends and family. They exchange ideas and learn from each other. "Investing Securely Together" is the cluster with the highest share of women and the highest share of novice investors. Their preference for security is also expressed in their asset allocation as they invest significantly more in ETFs and have the lowest value at risk.

Cluster 5

Short-Term Investing



Users who belong to the "Short-Term Investing" cluster are significantly more focused on short-term gains than users in all other clusters. The "Long-Term" factor has by far the lowest score. Investors in this cluster are often motivated by the thrill of investing. This cluster is the smallest of all the clusters. It has the lowest share of academics and a higher average age. The search for short-term gains is also expressed in their investment behavior. Compared to other clusters, it has the lowest share of ETFs and the highest value at risk. It is also noticeable that they achieve by far the lowest median annual return.

5. Investment behavior of users

The following chapter focuses on the actual investment behavior of users. How do both novice and experienced investors use neobrokers? Is the actual investment behavior of users in line with motives, investment principles and risk preferences expressed in the survey? Particular attention is paid to the question to what extent sustainable wealth accumulation can be derived from the user's investment behavior. This link is methodologically important as the response behavior to surveys is always subject to possible biases due to the "social desirability" of certain answers. One could argue, for example, that some respondents indicate that they are motivated to invest for the long-term as they anticipate that this is the socially desired response. If it turns out that actual investment behavior is consistent with expressed motives, this will significantly limit the risk of bias in the survey. It should also be noted that due to the relatively short existence of Trade Republic and the short observation period, it is only possible to infer initial findings rather than definitive statements about long-term investment behavior. The data will therefore only be indicative of or compatible with long-term wealth accumulation. Stronger evidence can only be inferred by running further surveys over longer time horizons.

5.1 Portfolio structure

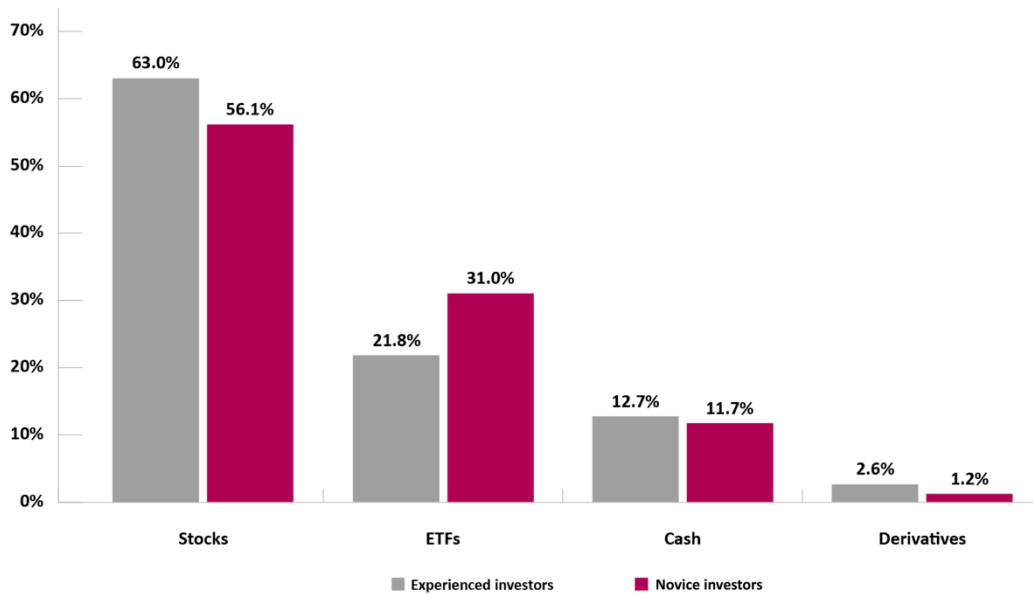
The first important indicator for the investment behavior of users is their portfolio structure. What is the users' share of stocks, ETFs and derivatives in their portfolio?¹³

- **The majority of the portfolio is invested in stocks with almost 60% and ETFs with 26%. Derivatives, which are significantly riskier than stocks and ETFs due to leverage effects, account for only 2% of the portfolios.** The remaining 12% are held in cash.
- Compared to experienced investors, novice investors invest a smaller share of their portfolios in stocks (56% vs. 63%) and derivatives (1.2% vs. 2.6%), and a significantly larger share in ETFs (31% vs. 22%). **Contrary to the widespread concern that young, inexperienced investors are tempted by neobrokers to invest in particularly risky financial products, novice investors predominantly invest in diversified, and therefore less risky products such as ETFs.**

¹³ These three asset classes include all securities that could be traded with Trade Republic during the survey period. Funds are not offered by Trade Republic. Cryptocurrencies could only be traded after the survey period and are therefore not yet included in the data set of this study.

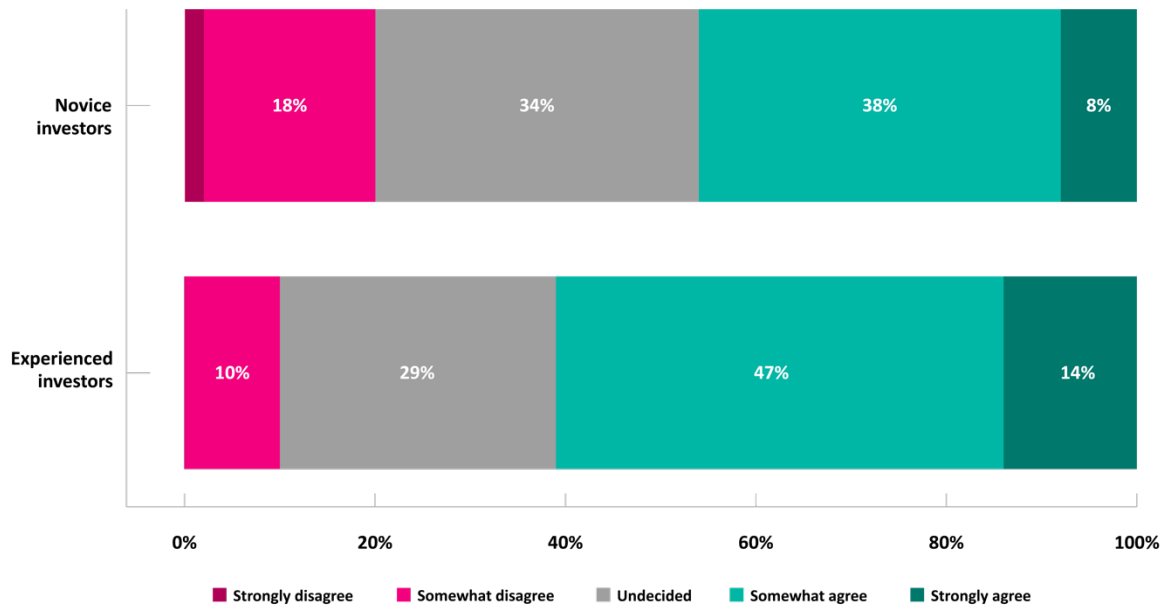
- The fact that investors who invest in the capital market for the first time via Trade Republic invest predominantly in low risk, diversified products such as ETFs is further supported by their risk preferences. Figure 5-2 shows that novice investors are less willing to take on higher risk in exchange for higher returns than experienced investors.

Figure 5-1: Composition of portfolios by experience level



Source: Trading data and survey (2021), cut-off date April 1, 2021, N = 209,980, users with assets of at least EUR 100 as of April 1, 2021, who actively executed at least one trade.

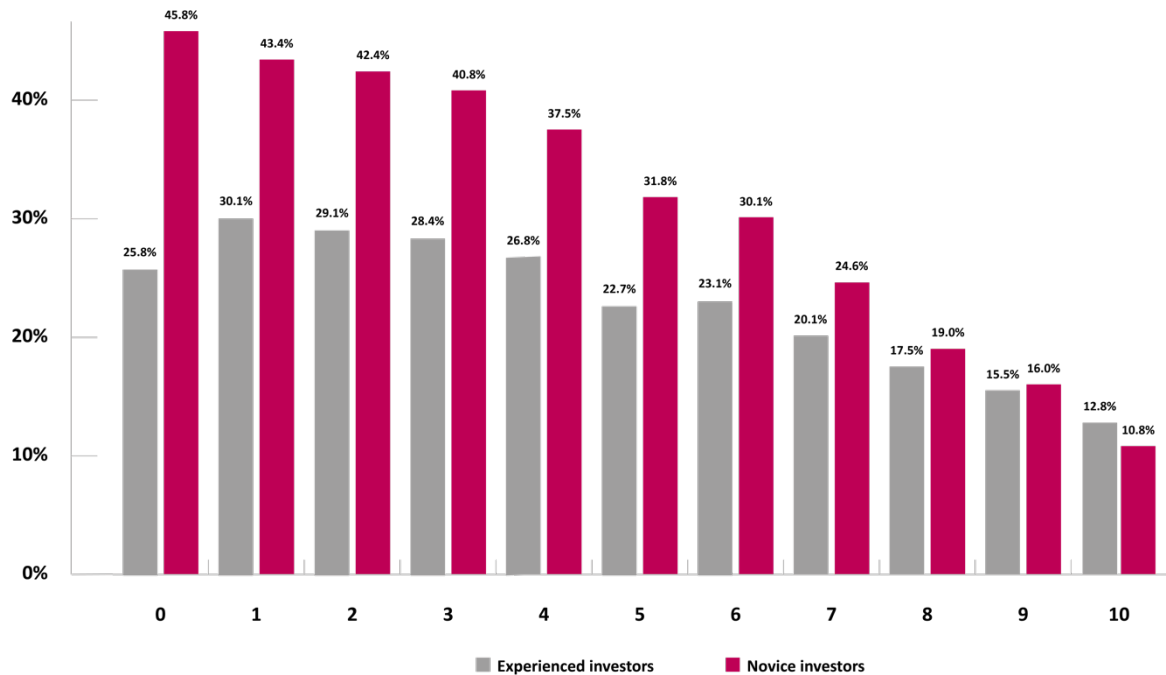
Figure 5-2: Agreement/disagreement with the statement: "For higher returns, I take on a higher risk" by experience level



Source: Survey (2021), N = 216,224, users with assets of at least EUR 100 as of April 1, 2021 who have executed at least one trade.

- In addition, the portfolio structure of users tends to be in line with the risk preferences expressed in the survey. Figure 5-3 shows that the share of ETFs in a user’s portfolio decreases the higher the user’s risk tolerance is. This correlation is particularly pronounced for novice investors. While novice investors with a low risk tolerance invest more than 40% of their portfolio in ETFs, the share for novice investors with a higher risk tolerance is between 10% and 20%. This indicates that novice investors invest indeed according to their risk preferences. In addition, the figure shows once again very clearly that novice investors invest significantly more in ETFs than experienced investors.

Figure 5-3: Share of ETFs in Trade Republic portfolio according to risk self-assessment



Note: Classification of users into deciles based on risk self-assessment. 0 = lower risk tolerance. 10 = highest risk tolerance. Source: Trading data and survey (2021), cut-off date April 1, 2021, N = 209,980, users with assets of at least EUR 100 as of April 1, 2021, who actively executed at least one trade.

5.2 Value at risk

Another relevant indicator for examining the investment behavior of neobroker users is the value at risk (VaR), which is a common risk measure in the financial world. The value at risk measures the maximum loss that will not be exceeded with a certain probability in a certain time period. In this case, it is the daily loss level that will not be exceeded in 95% of all cases based on the 250 trading days prior to the cutoff date (March 31, 2021).

The median value at risk for all users is 2.7%. This means that based on previous trading days, the portfolio will not lose more than 2.7% in value on any given trading day with a probability of 95%.¹⁴ For comparison Table 5-4 shows the value at risk of various indices. The median value at risk (2.7%) corresponds approximately to the value at risk of the NASDAQ Index (2.5%) and is only slightly higher than the value at risk of the DAX (1.6%).

¹⁴ To calculate the value at risk, the daily performance of the portfolio over the last 250 trading days was considered.

Table 5-4: Value at Risk of users and indices as of March 31, 2021

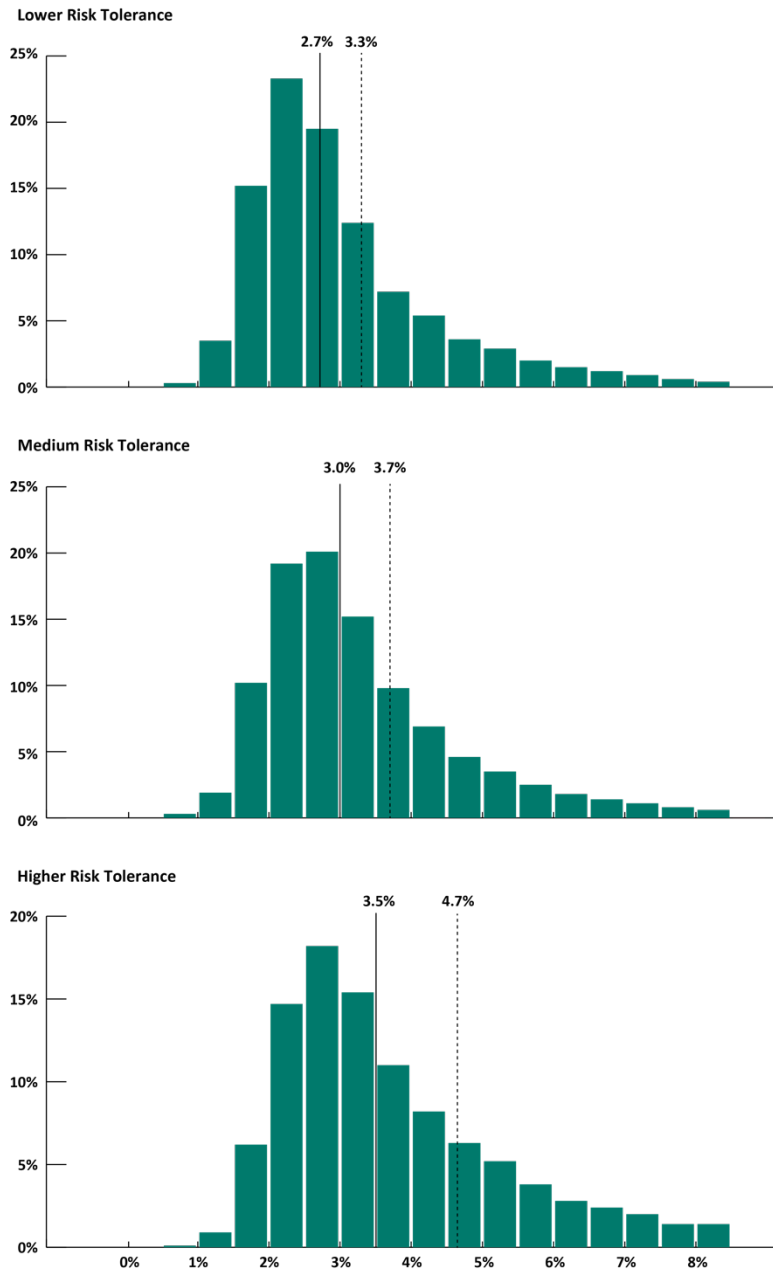
| | Value at risk |
|-------------------------------|--------------------|
| Trade Republic users (mean) | 3.65 ¹⁵ |
| Trade Republic users (median) | 2.68 |
| Nasdaq | 2.51 |
| DAX | 1.62 |
| MSCI World | 1.60 |

Source: Own calculations, historical prices DAX, NASDAQ and MSCI World of the 250 trading days prior to March 31, 2021, Trade Republic. Users with assets of at least EUR 100 as of April 1, 2021, who actively executed at least one trade.

Figure 5-5 shows the distribution of VaR by risk self-assessment. Compared to users with a low risk tolerance, the distribution shifts to the right for investors with medium and higher risk tolerances. The median VaR increases from 2.7% for risk-averse investors to 3% and 3.5% for users with medium and higher risk tolerances, respectively. This can be seen as further evidence that neobroker users act according to their risk preferences.

¹⁵ The mean VaR (3.65) differs slightly from the mean VaR (3.8) stated in table 4-2 above, since table 4-2 only refers to Trade Republic users who participated in the survey, while table 5-4 refers to all active Trade Republic users.

Figure 5-5: Distribution of value at risk according to risk self-assessment



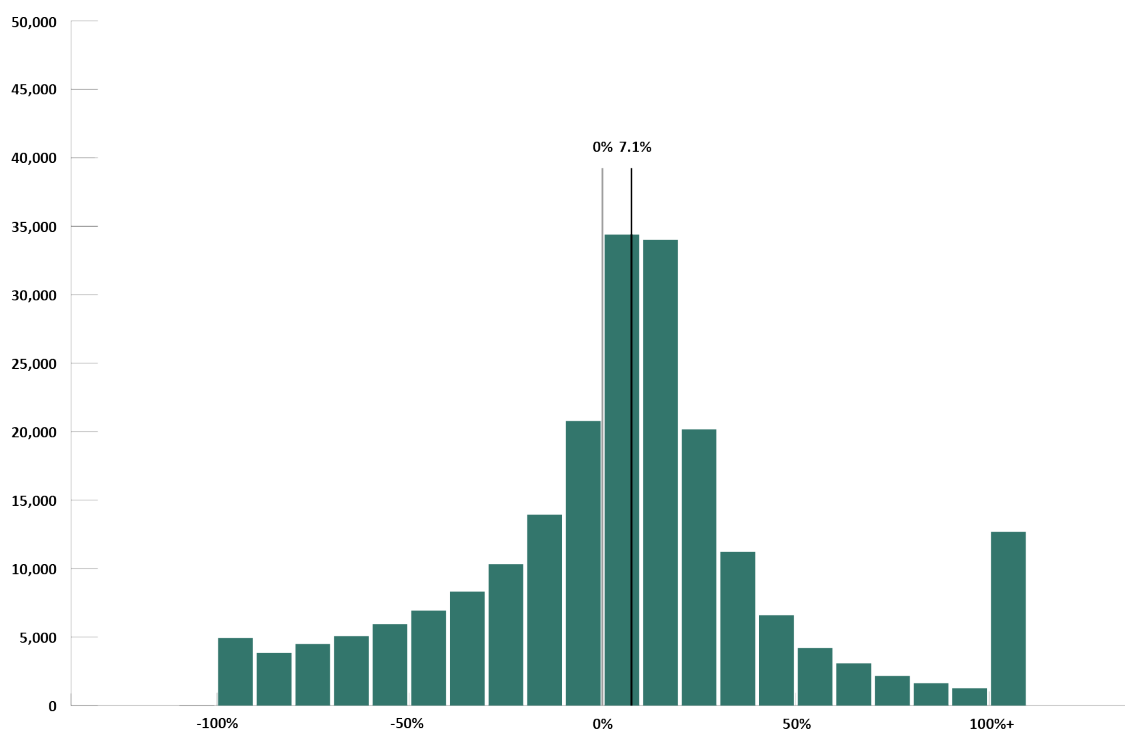
Note: Distribution of value at risk within that sub-segment of risk tolerance. Black solid line = median value at risk; dashed line = mean value at risk. Source: own calculations, Trade Republic survey, N(risk-averse) = 12,846, N(risk-neutral) = 158,783, N(risk-tolerant) = 28,545.

5.3 Annualized return

Next to risk, return is another key performance indicator of any portfolio. We analyse the annualized return, which measures the annual return of a portfolio. It should be noted that most users have only recently started investing in the capital market via neobrokers so that the annual return is calculated based on a short period of time, which limits its significance.

The median annualized return of the users surveyed is 7.1%. At the same time, Figure 5-6 shows the distribution underlying this median return. 60% of the users achieved a positive return.

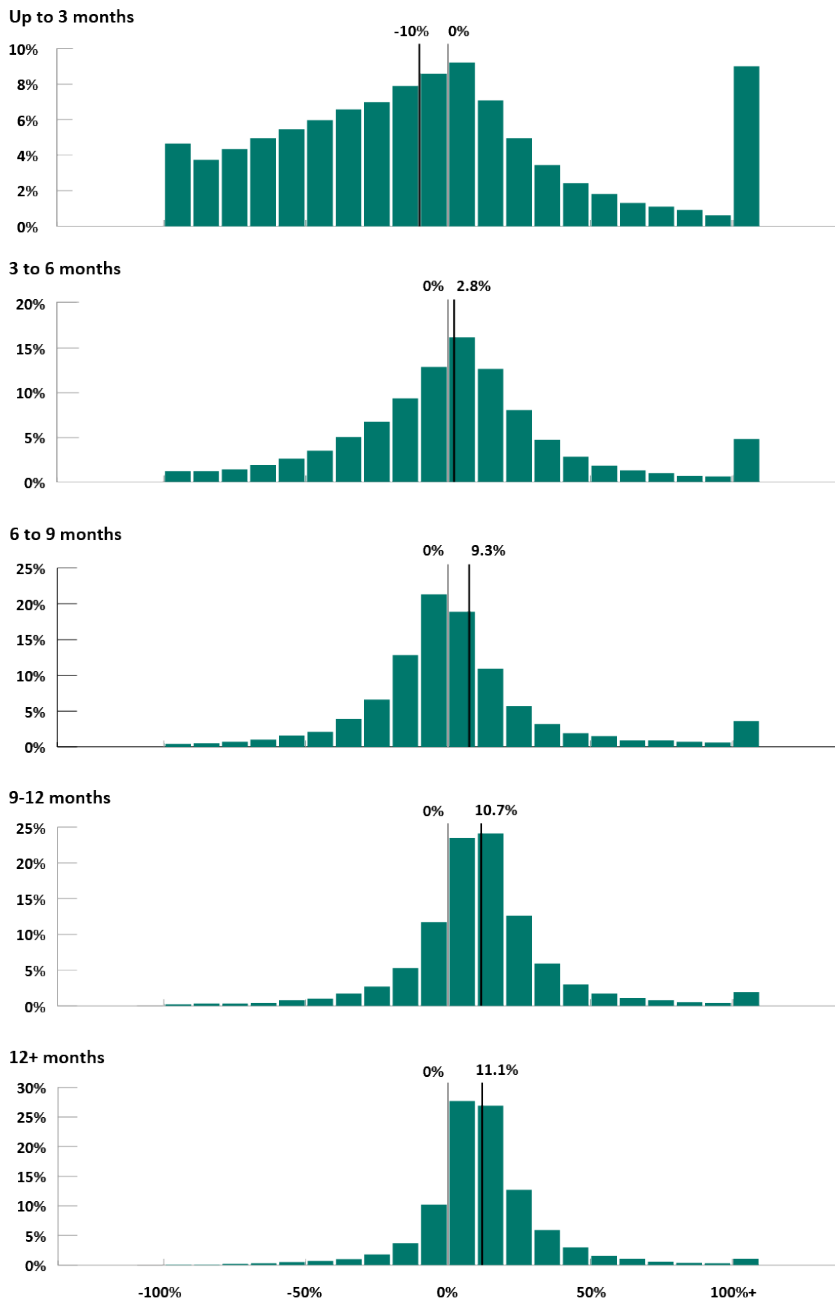
Figure 5-6: Distribution of annualized returns



Note: Gray line = 0 percent; black dashed line = median. Source: own calculations, N = 215,991.

The percentage of users with a positive return increases significantly the longer users have been investing with Trade Republic. While 45% of users who have been investing for 3 months achieved a positive return, this increases to 57% for users who have been investing for 3 to 6 months, to 78% for 9 to 12 months, and to 83% for users who have been investing for more than 12 months. Figure 5-7 shows the distribution of annualized returns by time in the market with Trade Republic. The distribution shifts to the right over time as both the median annualized return and the proportion of users with a positive return increase. At the same time, the variance of the distribution decreases, and the returns of the users are clustered more closely around the median return.

Figure 5-7: Distribution of annualized returns by time in market



Note: Distribution of returns within that sub-segment of time in market. Gray line = 0 percent; black line = median. Source: own calculations, N (Up to 3 months) = 65,107, N(3-6 months) = 47,572, N(6-9 months) = 30,321, N (9-12 months) = 34,407, N(12+ months) = 38,865.

6. Discussion

This chapter discusses to what extent the findings on the motives and behavior of the new generation of investors can be used to derive implications for current and future societal challenges.

It is in particular discussed, if and to what extent neobrokers (and the new investment trends that they enable) can contribute to closing the pension gap.

Neobrokers can potentially make an important contribution to closing the pension gap

The pension level, i.e., the ratio of average pension payments to average wages, has steadily declined in recent years. This decline in pension levels, or to put it another way, the **increase in the pension gap**, is expected to further rise in the coming years. The ongoing **demographic change**, i.e., the declining number of people of younger age and the simultaneous increase in the number of older people, puts growing pressure on the pay-as-you-go statutory pension scheme (“umlagefinanzierte gesetzliche Rentenversicherung”, GRV). With the baby boomer generation currently starting to retire, the pressure on the GRV will increase even further in the coming years up until 2035 and remain stable thereafter (Werding, 2016).

It is therefore expected that the contribution rates to the GRV will continue to rise while pension levels will continue to fall. The Scientific Advisory Council of the German Federal Ministry of Economics (Wissenschaftlicher Beirat beim BMWi, 2021) therefore concludes that it will not be possible to adhere to the double stop line (upper limit for contribution rate of 20% and lower limit for security level of 48%) introduced by the Grand Coalition in 2018. However, the new federal government announced in its coalition agreement in November 2021 that it continues to commit to this double stop line. To safeguard this commitment in a way that is appropriate for all generations, the government intends to invest in partial funding of the statutory pension scheme.

Most researchers agree that the GRV alone does not provide sufficient retirement provision due to demographic change in Germany, and that it therefore must be supplemented by **voluntary private** and/or **company pension schemes**. Today, however, neither state-subsidized private pensions (also known as **Riester pension**) nor occupational pensions are sufficiently widespread to close the pension gap. A survey conducted as part of the 2020 Report on retirement pensions (Alterssicherungsbericht 2020) found that only around 66% of employees between the ages of 25 and 65 have a claim against a supplementary pension from the Riester pension or company pension scheme. Around 35% of respondents have no supplementary pension provision; among low-income earners, this number is

almost 50% of all respondents (BMAS, Ergänzender Bericht der Bundesregierung zum Rentenversicherungsbericht 2020 gemäß § 154 Abs. 2 SGB VI, Alterssicherungsbericht 2020, Report of the German government on pension insurance, 2020).

The new federal government has recognized the need to stimulate investments in private pension schemes. According to the coalition agreement, the government plans to fundamentally reform the current system of private pension provision. In particular, the government intends to examine whether alternative investment options with higher returns than Riester options should be recognized. In addition, the government plans to provide financial incentives for low-income households to invest in these investment opportunities. The new government's reform plans are partly motivated by an unsatisfactory, or at least controversial, performance of the Riester pension, which was introduced 20 years ago as a state-subsidized private pension, are therefore controversial (Börsch-Supan, Bucher-Koenen, Goll, & Maier, 2016a). The low participation in the Riester pension is attributed to the complicated cost structure and high transaction costs when switching and terminating contracts (Börsch-Supan, Bucher-Koenen, Goll, & Maier, 2016a). There are also often very large cost differences between equivalent products in the Riester pension (Gasche, Bucher-Koenen, Haupt, & Angstmann, 2013). Consequently, this intransparency of costs and the high transaction costs mean that many households do not decide for a particular product and ultimately save too little for their retirement (Börsch-Supan, Bucher-Koenen, Goll, & Maier, 2016a). Moreover, the expected returns of many Riester pension products are currently low due to the prevailing **low interest rate environment** (Börsch-Supan, Bucher-Koenen, Goll, & Maier, 2016a). Particularly in the case of traditional bank savings plans, the low interest rate environment has a negative impact on retirement provisions. A study conducted by the Bundesbank shows that most respondents have not adapted their savings behavior to the low-interest environment (Bundesbank, 2015). Households have overwhelmingly invested in deposits despite negative real returns in some cases (Bundesbank, 2015). Almost two fifths of private financial assets were deposited with banks in 2016 in Germany, while only around 4.6% of savings were held in the form of stocks (Holzhausen, 2018). International comparisons and model simulations show that risk-conscious, return-oriented investing in the capital market can achieve savings targets quicker, which is necessary for retirement (Holzhausen, 2018).

In addition to traditional savings products from banks, German investors rely primarily on **real estate** as a form of retirement provision (Handelsblatt, 2021). However, real estate is often difficult for young people to finance and ties up a lot of capital, which can restrict mobility and thus one's professional future.

The main problem, however, is that young people do not save enough for retirement in the first place. Börsch Supan, et al. (2016b) find that younger households, as well as households with low incomes and low levels of education have problems closing the pension gap.

However, younger generations are becoming increasingly aware of the problem of retirement planning. A survey among first time voters concluded that the future of retirement is the second most important issue behind the fight against climate change (Ranke, 2021). In the wake of the COVID-19 pandemic, confidence in securities as a form of retirement provisions has increased significantly in Germany, according to a HDI survey in 2021, and ranked second after home ownership (Handelsblatt, 2021). This increasing trust in securities as retirement provision products correlates in time with the emergence of neobrokers and their rapidly growing number of users.

Neobrokers like Trade Republic serve and promote the younger generation's growing awareness of retirement planning and their demand for corresponding investment products for the capital market. The results of this study show that neobrokers provide access to the capital market especially for young investors: 47% of Trade Republic users invest in the capital market for the first time and almost 70% of the users are under 35 years old. Furthermore, it is evident that most of this young generation of users is consciously pursuing a long-term investment strategy, aiming to save for retirement. Against the backdrop of the prevailing low interest rate environment, 77% of users currently see no other lucrative alternative than saving in the capital markets. **The growing number of young people investing in the capital market for the first time via neobrokers can thus make an important contribution to retirement provision and help reduce the pension gap.**

More than three quarters of the users surveyed (77%) state that they have been thinking more about asset accumulation and retirement planning since they started investing in capital markets. This can also potentially lead to an improvement in the **financial literacy** of investors. Women, low-income earners, and East Germans, in particular, are characterized by low financial literacy (Bucher-Koenen, 2009). Studies have shown that there is a correlation between financial literacy and engaging with private retirement planning: people with a higher level of financial literacy are more likely to invest in private retirement provision, while an engagement with their own private retirement planning increases their financial literacy (Bucher-Koenen, 2009). The extent to which neobrokers like Trade Republic can actually make a positive contribution to the financial literacy of their users could be investigated more closely in future studies.

7. Conclusion

The preceding analysis of a survey among neobroker users, which is unique in its scope, in combination with detailed investment data has provided insights into the motives and actual investment behavior of a young and new generation of investors. The results of this study show that the overwhelming majority of investors use neobrokers to make a long-term contribution to retirement provisions with their investments. Only a small minority of users are motivated by short-term gains and thrill.

Users' long-term investment motives are further confirmed by the analysis of their actual investment behavior. Portfolios consist on average of 60% stocks and of 26% ETFs. Derivatives, which are significantly riskier than stocks and ETFs given their leverage, account for only 2%. Users who invest in the capital market for the first time with the help of Trade Republic invest a higher share of their assets in ETFs and a lower share in stocks and derivatives than experienced investors. This is also supported by survey results, which show that novice investors are less willing to take on increased risk for higher returns.

Due to the current low-interest environment, classic bank saving products do not offer sufficient returns for long-term retirement provisions. This is confirmed by the fact that 77% of neobroker users invest in the capital market because there is no lucrative alternative to save. Neobrokers such as Trade Republic support and cater to the growing demand of young people to save in the capital market by simplifying the process of opening an account and investing as well as by lowering costs. Another result of easy access and lower costs is that women and investors who belong to the lower half of the income distribution in particular are now empowered to invest in capital markets. 77% of users are under 35 and 47% are investing in the capital market for the first time through Trade Republic. Neobrokers like Trade Republic can therefore potentially make an important contribution to closing the pension gap.

8. Bibliography

- Aktieninstitut, D. (2021). *Aktionärszahlen des Deutschen Aktieninstituts 2020 (Shareholder figures of Deutsches Aktieninstitut 2020)*. Frankfurt am Main.
- Barasinskar, N., Schaefer, D., & Stephan, A. (2012). Individual risk attitudes and the composition of financial portfolios: Evidence from German household portfolios. *Quarterly Review of Economics and Finance*, 52, S. 1-14.
- BMAS, B. f. (2020). *Ergänzender Bericht der Bundesregierung zum Rentenversicherungsbericht 2020 gemäß § 154 Abs. 2 SGB VI (Alterssicherungsbericht 2020) (Report of the German government on pension insurance)*. Berlin.
- BMAS, B. f. (2021). *Lebenslagen in Deutschland - Der 6. Armuts- und Reichtumsbericht der Bundesregierung (Living Conditions in Germany - The 6th Poverty and Wealth Report of the Federal Government)*. Berlin.
- BMWi, Wissenschaftlicher Beirat. (2021). *Vorschläge für eine Reform der gesetzlichen Rentenversicherung (Proposal for a reform of the statutory pension scheme)*. Berlin: Bundesministerium für Wirtschaft und Energie.
- Börsch-Supan, A. H., Bucher-Koenen, T., Ferrari, I., Kutlu-Koc, V., & Rausch, J. (2016b). *Die Entwicklung der Rentenlücke und das Sparverhalten deutscher Haushalte (The development of the pension gap and savings behavior of German households)*. München: MEA Discussion Paper, 02-2016, Munich Center for the Economics of Aging.
- Börsch-Supan, A. H., Bucher-Koenen, T., Goll, N., & Maier, C. (2016a). *15 Jahre Riester - Eine Bilanz (15 Years of the Riester Pension Scheme - Taking Stock)*. München: MEA Discussion Paper, 06-2016, Munich Center for the Economics of Aging.
- Börsch-Supan, A. H., Rausch, J., Buslei, H., & Geyer, J. (2020). *Entwicklung der Demographie, der Erwerbstätigkeit sowie des Leistungsniveaus und der Finanzierung der gesetzlichen Rentenversicherung (On the Development of Demography, Employment, Public Pension Levels, and Funding of Public)*. Berlin: DIW Discussion Papers 1856.
- Bucher-Koenen, T. (2009). *Financial Literacy and Private Old-Age Provision in Germany – Evidence from SAVE 2008*. München: MEA Discussion Paper, No. 192-2009, Munich Center for the Economics of Aging.
- Bundesbank, D. (2015). *Das Spar- und Anlageverhalten privater Haushalte in Deutschland vor dem Hintergrund des Niedrigzinsumfelds (The savings and investment behavior of private households in Germany against the background of low interest rates)*. Frankfurt am Main: Monatsbericht Oktober.

- Chauvin, B., Hermand, D., & Mullet, E. (2007). Risk Perception and Personality Facets. *Risk Analysis* 27(1), S. 171-185.
- Gasche, M., Bucher-Koenen, T., Haupt, M., & Angstmann, S. (2013). *Die Kosten der Riester-Rente im Vergleich (The costs of the Riester Pension in comparison)*. München: MEA Discussion Paper, 04-2013, Munich Center for the Economics of Aging.
- Handelsblatt. (02. 09 2021). *Umfrage: Aktien gewinnen bei Altersvorsorge an Akzeptanz (Survey: Equities gain acceptance for retirement provision)*. Von <https://www.handelsblatt.com/politik/deutschland/hdi-berufe-studie-umfrage-aktien-gewinnen-bei-altersvorsorge-an-akzeptanz/27572690.html?ticket=ST-554590-on2qEF1rZ1Wa0KjRG3IQ-ap6> abgerufen
- Holzhausen, A. (2018). Die Deutschen sparen sich arm – Eine Bestandsaufnahme des Sparverhaltens in Deutschland (The Germans are saving themselves poor - Stocktaking of savings behavior in Germany). In H. Beyer, & H. J. Naumer, *CSR und Mitarbeiterbeteiligung. Management-Reihe Corporate Social Responsibility*. Berlin, Heidelberg: Springer Gabler.
- Ranke, C. (14. 09 2021). *Jungwähler sorgen sich zunehmend um Rente. Redaktionsnetzwerk Deutschland. (Young voters are worrying more about their pension)*. Von <https://www.rnd.de/politik/rente-jungwaehler-sorgen-sich-zunehmend-um-altersvorsorge-ZVZ5WQCYYVCHXFBYYSE6YAUF5I.html> abgerufen
- Rosen, A., Tsai, J., & Downs, S. (2003). Variations in Risk Attitude across Race, Gender and Education. *Medical Decision Making* 23, S. 511-517.
- Werding, M. (2016). Rentenfinanzierung im demographischen Wandel: Tragfähigkeitsprobleme und Handlungsoptionen (Financing pensions in times of demographic change: problems of sustainability and options for action). *Working Papers 05/2016, Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung*.
- Wiedemann, P., & Mertens, J. (2005). Sozialpsychologische Risikoforschung (Socio-psychological risk research). *Technikfolgeabschätzung - Theorie und Praxis* 3(14), S. 38-45.

Appendix: Methodological Explanations

Exploratory Factor Analysis

The starting point of exploratory factor analysis is the assumption that the approval or disapproval of statements is due to latent ("underlying") values and principles of the respondents. In multivariate statistics, these latent values and principles are called factors. Latent factors cannot be measured explicitly, but they have an implicit effect on measured response behavior. A factor is more important the more statements correlate with it. To determine which factors best describe the statements at hand, the so-called eigenvalue of the factors is calculated on the basis of a correlation analysis. This indicates how much information is contained in the factor. An eigenvalue greater than one then corresponds to an information content of more than one statement. Each factor that describes more than one statement is helpful in the basic explanation of the response behavior and is added as a factor to the final analysis. The factor analysis is then repeated with the number of relevant factors. This procedure ensures that as much of the observed variance in the original data set can be explained with as few factors as possible. Each additional factor would then provide only marginally more information.

Cluster analysis

Cluster analysis is a procedure designed to identify similarity structures in large data sets. In this study, a k-means algorithm is applied, which aims to minimize the squared sum of the distances of all data points to the nearest cluster center. Theoretically, any number of clusters can be chosen. However, too many clusters lead to the problem of overfitting, so that the position of each cluster depends too much on random variance in the data set. In this study, the optimal number of clusters is determined by the Elbow Method. Here, the proportion of variance explained by clustering is considered as a function of the number of clusters. The choice then falls on a number of clusters where an additional cluster contributes only marginally to the reduction of the squared sum of distances.