ECONtribute
MARKETS & PUBLIC POLICY

ECONtribute
Discussion Paper No. 128

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November 2021 www.econtribute.de

UNIVERSITÄT BONN Universität zu Köln

Funding by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany´s Excellence Strategy – EXC 2126/1– 390838866 is gratefully acknowledged.

Beliefs About the Stock Market and Investment Choices: Evidence from a Field Experiment*

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November 25, 2021

Abstract

We survey retail investors at an online bank to study beliefs about the autocorrelation of aggregate stock returns, and how these beliefs shape investment decisions measured in administrative account data. Individuals' beliefs exhibit substantial heterogeneity and predict trading responses to market movements. We inform a random half of our respondents that historically the autocorrelation of aggregate returns was close to zero, which persistently changes their beliefs. Among those initially believing in mean reversion, treated respondents buy significantly less equity during the COVID-19 crash four months later. Our results highlight how heterogeneity in subjective models causally drives trade in asset markets.

JEL Classification: D14, D83, D84, D91, E71.

Keywords: Expectation Formation, Information, Updating, Retail Investors, Trading.

*We are grateful for helpful comments from Michalis Haliassos, Michael Kosfeld, Theresa Kuchler, Christoph Merkle, Arna Olafsson, Enriquetta Ravina, Chris Roth, Sonja Settele, Ernst-Ludwig von Thadden, Clemens Wagner, Ruediger Weber, Joachim Winter and Basit Zafar, from seminar audiences at WU Vienna, the University of Copenhagen, Copenhagen Business School, the University of Sussex, the University of Tuebingen, Goethe University Frankfurt, the University of Bonn, the University of Cologne, and the Helsinki Finance Seminar, and from participants at the WAPFIN conference (NYU Stern), the European Finance Association Annual Meeting, the Field Days Workshop, the SGF Annual Conference, the CEBI Workshop of Subjective Beliefs in Macro and Household Finance, the International Conference on Household Finance (Bundesbank), the Society for Experimental Finance Conference, and the Joint ECB-NY Fed Conference on Expectations Surveys. We received ethics approval from Goethe University Frankfurt. We thank the Center for Economic Behavior and Inequality (CEBI), Goethe University Frankfurt, the Joachim Herz Foundation, INQUIRE Europe, and the Society for Experimental Finance for financial support. The activities of the Center for Economic Behavior and Inequality (CEBI) are funded by the Danish National Research Foundation, Grant DNRF134. Support from the Danish Finance Institute (DFI) is gratefully acknowledged. Laudenbach: Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany´s Excellence Strategy – EXC 2126/1–390838866

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1 Introduction

A growing literature in macroeconomics and finance documents substantial heterogeneity in the subjective models of the economy individuals rely on in their expectation formation, which in turn offers an explanation for disagreement in expectations about macroeconomic outcomes (Coibion and Gorodnichenko, 2012; Giglio, Maggiori, Stroebel and Utkus, 2021a). For instance, Armona, Fuster and Zafar (2019) show that large fractions of households underestimate the longer-run mean reversion in local home price growth. Andre, Pizzinelli, Roth and Wohlfart (2021) document a large extent of heterogeneity in households' beliefs about the effects of macroeconomic shocks on unemployment and inflation. In the context of the aggregate stock market, different groups of households seem to believe in persistence – a positive autocorrelation – (Adam, Marcet and Beutel, 2017; De Bondt, 1993; Greenwood and Shleifer, 2014; Vissing-Jorgensen, 2003) or in mean reversion – a negative autocorrelation – of returns (Dominitz and Manski, 2011; Heiss, Hurd, van Rooij, Rossmann and Winter, 2019), even though empirically the autocorrelation of aggregate returns is close to zero, at least at the annual frequency (Huang, Li, Wang and Zhou, 2020).[1] But do differences in individuals' mental models causally lead to differences in economic decisions? The answer to this question ultimately determines the importance of accounting for heterogeneity in subjective models in theoretical and empirical research.

In this paper, we use an information intervention to study this question in the context of beliefs about the autocorrelation of aggregate stock returns. Beliefs about the stock market provide an ideal setting, for the following reasons: first, there are large discrepancies between individuals' beliefs of persistence or mean reversion of returns and actual empirical facts. Second, heterogeneity in subjective models of the world is a common theoretical explanation for trade in asset markets (Harrison and Kreps, 1978; Scheinkman and Xiong, 2003). Third, in light of the increasing importance of stock investment for retirement saving, it is of direct interest to better understand individuals' belief formation about stock returns and the role of beliefs in their investment decisions.

We conduct a survey of about 2,000 stockholders that are clients of a major German

[1]While predictability based on the past 12-month return is small, the literature has documented predictability of aggregate returns based on manager sentiment and a range of macroeconomic variables (Jiang, Lee, Martin and Zhou, 2019). Moreover, there is a large body of evidence indicating momentum in the returns of individual stocks (Asness, Moskowitz and Pedersen, 2013).

online bank. In our survey, we elicit respondents' beliefs about the historical autocorrelation of stock returns based on a new, individual-level measure. Specifically, we first ask respondents to think of six intervals of historical annual return realizations of the German stock market index (DAX) during the last 50 years. For each return interval, respondents are asked to provide an estimate of the average return of the DAX over the subsequent 12 months if the return over the previous 12 months fell into that interval. Subsequently, a random half of the respondents are informed about the actual historical conditional mean return over the following year for each of the six scenarios of returns over the previous year. Actual conditional mean returns in the six scenarios vary only narrowly around the unconditional historical average return of the DAX of 8.5 percent, illustrating the historical low degree of predictive power of recent returns for future returns at the annual frequency. In both the main survey and a follow-up survey conducted four weeks later, we then measure our respondents' posterior beliefs about the autocorrelation of stock returns and the return over the 12 months after the survey.

Our setup generates exogenous variation in individuals' beliefs about the autocorrelation of aggregate stock returns, which in turn allows us to examine whether subjective models of the stock market are a causal driver of people's return expectations. Moreover, by linking the treatment variation with administrative account data on trading decisions before and after the intervention, we can obtain causal evidence on the role of individuals' perceived models of the stock market in their investment decisions. Due to the randomized nature of our information intervention, our experimental evidence is immune to concerns related to omitted variables, reverse causality or measurement error, which often plague correlational evidence on the relationship between beliefs and economic decisions.

We document four main sets of results. First, we provide descriptive evidence on our respondents' prior beliefs. There is a large degree of heterogeneity in beliefs about the historical autocorrelation of stock returns, with more than half of investors believing in mean reversion, and about one fourth believing in persistence, depending on the exact classifications we use. Strikingly, respondents with higher education, financial literacy, investment experience or wealth are more likely to erroneously believe in mean reversion of aggregate returns. Moreover, respondents' beliefs about the autocorrelation of aggregate returns have strong predictive power for their expectations about the one year-ahead return at the time of the survey. This suggests that part of the disagreement in return

expectations in the stock market is due to differences in subjective models of the stock market across investors.

Second, we study whether respondents' perceived autocorrelation of aggregate returns matches the timing of their equity transactions at the online bank over the five years before the intervention. Respondents reporting a belief in mean reversion are significantly more likely to purchase equity following negative stock market returns compared to those believing in persistence of aggregate returns, conditional on permanent differences across groups. By contrast, investors' selling decisions are largely inelastic to beliefs about the historical autocorrelation, consistent with the idea that buying decisions tend to be forward-looking, while selling decisions may mostly be driven by other motives (Barber and Odean, 2013). Moreover, beliefs about the historical autocorrelation of stock returns predict fluctuations in the equity share of respondents' holdings with the bank over time. These findings validate our survey measure, and suggest that beliefs about the autocorrelation of aggregate returns play a role in retail investors' trading decisions.

Third, we examine the effect of the information intervention on individuals' beliefs. The treatment strongly increases respondents' agreement to a verbal statement that the stock market will likely yield a positive return independently of the return realized over the previous year. Moreover, the treatment strongly reduces respondents' previous beliefs in mean reversion or persistence of aggregate returns, as measured by their agreement with two according verbal statements. Our treatment completely closes the gaps in beliefs between previous mean reverters and those who perceived an autocorrelation close to zero before the intervention. The information also induces respondents to update their expectations about the return of the German stock market over the 12 months after the survey in line with the change in their perceived autocorrelation. Most of the experimentally induced changes in beliefs persist at about the same magnitude in a follow-up survey conducted four weeks after the intervention, mitigating concerns related to experimenter demand effects or numerical anchoring (Cavallo, Cruces and Perez-Truglia, 2017; Haaland, Roth and Wohlfart, 2021). Taken together, these findings highlight that investors' subjective models of the stock market are highly elastic, and can be persistently changed through provision of factual information. Moreover, these results imply that heterogeneity in the perceived autocorrelation of returns is a causal driver of disagreement in stock return expectations.

Finally, we study whether respondents adjust their trading behavior as measured in administrative account data in response to the information. The experimentally induced changes in beliefs cause only minor adjustments in respondents' equity investments over the first months after the survey, during which the stock market was fairly stable. However, treated mean reverters display a significantly smaller increase in equity purchases in response to the COVID-19 stock market crash four to five months after the intervention compared to non-treated mean reverters. This is consistent with the idea that our treatment reduces the increase in return expectations triggered by the crash among this group. Our treatment closes between 60 and 100 percent of the gap in trading reactions to the shock between mean reverters and non-mean reverters as measured in the control group. These findings suggest that retail investors' subjective models of the stock market causally affect their trading decisions. Moreover, the large effects of our treatment four to five months later highlight that simple de-biasing interventions changing investors' perceived models of financial markets can have very persistent effects on their investment choices.

We contribute to a literature measuring individuals' subjective models of the economy in different contexts (Adam, Marcet and Beutel, 2017; Andrade, Crump, Eusepi and Moench, 2016; Andre, Pizzinelli, Roth and Wohlfart, 2021; Armona, Fuster and Zafar, 2019). Heterogeneity in perceived models offers an alternative to information frictions as an explanation for the widely documented disagreement in expectations about macroeconomic outcomes (Coibion and Gorodnichenko, 2012; Giglio, Maggiori, Stroebel and Utkus, 2021a; Mankiw, Reis and Wolfers, 2003). Our findings highlight substantial heterogeneity in subjective models of the stock market, which in turn causally drives differences in return expectations across households. Retail investors' subjective models also causally affect their investment choices, which suggests that heterogeneity in subjective models is potentially an important driver of trade in asset markets. Our findings are in line with a class of models in which trade arises due to differences in how investors evaluate the same piece of information (Harrison and Kreps, 1978; Scheinkman and Xiong, 2003). More generally, our evidence highlights the importance of accounting for heterogeneity in subjective models across agents in empirical and theoretical research in macroeconomics and finance.

Several previous studies have provided evidence of beliefs in persistence or mean rever-

sion of aggregate stock returns. Some papers document that average return expectations reported in household surveys increase following high return realizations (Adam, Marcet and Beutel, 2017; De Bondt, 1993; Greenwood and Shleifer, 2014; Vissing-Jorgensen, 2003). Other papers use panel data to classify individuals according to how they update their return expectations following changes in realized returns (Dominitz and Manski, 2011; Heiss, Hurd, van Rooij, Rossmann and Winter, 2019), and find that beliefs in persistence, beliefs in mean reversion, and beliefs that the stock market follows a random walk with drift are all fairly prevalent among households. There are some potential concerns with indirectly classifying individuals according to expectation revisions following market movements. First, market movements may be correlated with other variables affecting individuals' return expectations. Second, large fractions of individuals, particularly among those not participating in the stock market, may be inattentive to market movements. By contrast, our strategy of measuring beliefs in mean reversion or persistence directly in a common macroeconomic environment should be immune to such concerns. Another advantage of our setting is our focus on a sample of active retail investors – different to many prior studies, which have often focused on general population surveys, in which only a fraction of respondents invest in stocks. Most importantly, to the best of our knowledge ours is the first paper to provide direct causal evidence on the role of beliefs about the autocorrelation of aggregate returns in trading decisions.

A number of papers have used survey data to study the link between stock market beliefs and investor behavior (Ameriks, Kézdi, Lee and Shapiro, 2020; Amromin and Sharpe, 2013; Arrondel, Calvo-Pardo, Giannitsarou and Haliassos, 2021; Beutel and Weber, 2021; Das, Kuhnen and Nagel, 2020; Dominitz and Manski, 2007; Drerup, Enke and Von Gaudecker, 2017; Kézdi and Willis, 2011; Malmendier and Nagel, 2011; Vissing-Jorgensen, 2003). Most of these studies focus on the link between investor beliefs and the decision to participate in the stock market or the portfolio share invested in stocks. Only few studies have linked survey data with administrative account data to study the role of beliefs in investment decisions (Andersen, Hanspal, Martinez-Correa and Nielsen, 2021; Hoffmann, Post and Pennings, 2015; Merkle and Weber, 2014). For instance, Giglio, Maggiori, Stroebel and Utkus (2021a) show that return expectations of Vanguard clients measured in surveys correlate significantly with their investment decisions as measured in administrative data, but the relationship is an order of magnitude smaller than implied

by standard models. Giglio, Maggiori, Stroebel and Utkus (2021b) study the joint dynamics of stock return expectations and trading decisions of Vanguard clients during the COVID-19 crash. Meeuwis, Parker, Schoar and Simester (2021) study relative changes in investment decisions among households with different party affiliation around the 2016 presidential election, which are most likely driven by changes in beliefs. We add to this literature by exploiting experimental variation to study the causal effect of beliefs on investment decisions in the field.[2]

Our paper also contributes to a literature that uses information provision experiments to study macroeconomic expectation formation of households. This literature has shown that individuals update their beliefs in response to information about expert forecasts, realizations of macroeconomic variables or policy communication in the context of inflation (Armantier, Nelson, Topa, van der Klaauw and Zafar, 2016; Binder and Rodrigue, 2018; Cavallo, Cruces and Perez-Truglia, 2017; Coibion, Gorodnichenko and Weber, 2021b; D'Acunto, Fuster and Weber, 2021a), house prices (Fuster, Perez-Truglia, Wiederholt and Zafar, 2018), GDP growth (D'Acunto, Hoang, Paloviita and Weber, 2021b; Roth and Wohlfart, 2020), interest rates (Coibion, Georgarakos, Gorodnichenko and Weber, 2021a; Link, Peichl, Roth and Wohlfart, 2021), or stock returns (Hanspal, Weber and Wohlfart, 2020).[3] Closely related to our study, Armona, Fuster and Zafar (2019) use an information experiment to show that US households under-appreciate the long-run mean reversion in local house prices. Beutel and Weber (2021) examine how return expectations and allocations between an equity fund and a risk-free asset respond to information about past returns, earnings growth and expert forecasts. Different to previous papers, we shift respondents' beliefs about the time-series properties of the data-generating process and study effects on expectations and behavior. Moreover, our study is the first to link an information experiment with administrative data on actual investor decisions.[4] Our findings highlight that simple information interventions can significantly change individuals' economic decisions months later. From a methodological perspective, our results suggest

[2]Our paper is also related to a literature using laboratory experiments to study the role of beliefs in trading decisions (Kuhnen, 2015; Kuhnen and Knutson, 2011; Kuhnen, Rudorf and Weber, 2017).

[3]See Haaland, Roth and Wohlfart (2021) for a review of the literature using information provision experiments.

[4]A few other papers have linked information experiments shifting macroeconomic expectations with non-self-reported data on decisions, e.g. Coibion, Gorodnichenko and Weber (2021b), Coibion, Georgarakos, Gorodnichenko and Weber (2021a) and Galashin, Kanz and Perez-Truglia (2021) for inflation expectations and spending, and Bottan and Perez-Truglia (2020) in the context of home selling decisions.

that changes in expectations measured in information experiments capture adjustments of beliefs that are relevant for actual economic decisions, providing evidence on the validity of information experiments as a method to study belief formation.

Finally, our paper is related to a literature on the effectiveness of financial education interventions, which finds that such interventions have positive effects on knowledge and behavior in the context of personal finances (Kaiser, Lusardi, Menkhoff and Urban, 2021; Lusardi and Mitchell, 2014). While this literature has mostly focused on interventions taking at least several hours, our study demonstrates that also much shorter and low-cost information interventions can persistently change financial decision-making.

The rest of this paper is structured as follows. In Section 2 we present the experimental design and describe our sample. Section 3 provides descriptive evidence on respondents' prior beliefs and their correlation with trading decisions. In Section 4 we study how respondents change their beliefs and investment decisions in response to the intervention. Section 5 concludes.

2 Experimental design and data

In this section, we provide details on the experimental design, the administration of the survey, and the characteristics of our sample. Online Appendix E provides the survey instructions translated to English.

2.1 Main survey

Our experiment consists of three stages: i) a baseline stage eliciting respondents' prior beliefs; ii) a treatment stage in which respondents receive information; and iii) a final stage eliciting posterior beliefs and a set of background characteristics.

Baseline stage: Prior beliefs We first ask respondents about their perception of the return of the German stock market index (DAX) over the 12 months before the survey. We then elicit respondents' expectations about the return of the DAX over the 12 months after the survey. For both of these questions, participants are asked to provide a numerical estimate in percent. Upon entering an estimate, respondents are provided in real time with information on the value of an investment in the German stock market index initially worth 100 EUR at the end of the 12 months that is implied by their point forecast, directly

below the entry field.[5] We include this translation to address the finding that expectations elicited in surveys are sensitive to whether subjects are asked to forecast stock returns in percent or prices in units of currency (Glaser, Langer, Reynders and Weber, 2007; Glaser, Iliewa and Weber, 2019).

Our main interest lies in understanding respondents' beliefs about whether and how stock market returns depend on recently realized returns and how these beliefs affect their expectation formation and their behavior. To measure respondents' prior beliefs about the autocorrelation of stock returns, we present participants with six different intervals of 12-month return realizations of the DAX, which are mutually exclusive and collectively exhaustive.[6] For each interval, starting from the lowest one, we instruct respondents to think of all points in time over the past 50 years at which the return of the DAX over the preceding 12 months had fallen into the respective interval, and ask them to estimate the average return of the DAX over the subsequent 12 months if this was the case. For each return interval, the prediction is elicited on a separate screen. A graph displays respondents' estimates for the current as well as for all previous scenarios in real time as blue bars. Figure 1 Panel A displays an example survey screen after forecasts for all six scenarios have been submitted. If a respondent believes that historically the return of the German stock market was predictable by the realized return over the previous year, this should show up as non-constant estimates entered across the six bins. For instance, an upward sloping patter in the displayed graph would indicate extrapolative beliefs, while a downward sloping pattern would indicate a belief in mean reversion.[7]

Treatment stage: Non-informativeness of recent return realizations In the second stage of the experiment, a random half of the respondents are assigned into the treatment group, while the other half are assigned to the control group.

Respondents in the treatment group receive information on the actual historical average realizations of 12-month ahead returns for each of the six bins of returns over the

[5]E.g., a predicted return of 8 percent translates into an end-of-period portfolio value of 108 EUR.

[6]The intervals are "less than -20 percent", "between -20 and -10 percent", "between -10 and 0 percent", "between 0 and 10 percent", "between 10 and 20 percent", and "above 20 percent".

[7]In line with previous literature (Amromin and Sharpe, 2013; Dominitz and Manski, 2011; Giglio, Maggiori, Stroebel and Utkus, 2021a), we focus on nominal stock returns to make our survey questions easy to understand for participants. One concern could be that longer-run trends in the risk-free rate or inflation could give rise to a positive autocorrelation of nominal stock returns at the annual frequency. However, as can be seen in Figure 1, this is not the case for the German stock market, and also does not seem to hold more generally (Huang, Li, Wang and Zhou, 2020).

preceding 12 months. The actual mean realized returns displayed to respondents vary narrowly between 7.4 and 9.5 percent across the six intervals, and there is no clear monotone relationship between past 12-month returns and returns over the next 12 months. This illustrates that historically recent realized returns of the DAX have not been informative for future returns at the one-year horizon.[8]

The treatment is displayed on three screens. On the first screen, it is announced that the respondent will receive information on the actual average return realization for each of the six cases. On the second screen, respondents are again shown the graph displaying their prior estimates, illustrated as six blue bars. Respondents have to repeatedly click on a button and learn about the actual historical mean return realization over the next 12 months one-by-one for each interval of returns over the previous 12 months. Actual historical values are displayed as orange bars next to participants' priors. In addition, for each case, a written sentence is displayed above the graph that reminds participants of their corresponding prior and informs them about the actual historical average return realization. Participants are only able to continue to the next screen once they have requested and seen all six historical values. Figure 1 Panel B displays an example screen of the treatment graph once all six actual average return realizations are displayed. On the third screen, respondents are again shown the complete graph with both their own estimates and the actual historical values. In addition, we provide them with a short text summarizing the content of the treatment. Specifically, we inform them that over the past 50 years, stock returns did not systematically vary with return realizations over the previous year, and that the best forecast was close to the 8.5 percent unconditional historical average return irrespective of recent realizations. Moreover, to make the treatment information more logical to them, we provide a short explanation that any return predictability would be quickly exploited and removed by large institutional investors.[9]

Respondents in the control group receive no information on how informative last year's realized returns were for next year's returns in the different past-return scenarios, but are merely informed about the unconditional historical average annual return on the DAX

[8]These returns are calculated comparing weekly averages of aggregate stock prices over 12-month periods using data on the German stock market index (DAX) over the past 50 years. For the time before 1988, when the DAX was established, we use data from Thomson Reuters, which tracks back constituents until 1956. One of the values, a next-year average return, of 9.58 percent for previous returns between -10 and 0 percent, was accidentally rounded to 9.5 instead of 9.6 in the information displayed to respondents.

[9]Respondents can only continue the survey once they have stayed on this last screen for at least 15 seconds.

over the last 50 years of 8.5 percent. We provide this information to the control group because respondents' beliefs about the unconditional average historical return could also be affected by the treatment. By comparing respondents in the treatment and the control group we can therefore identify the effect of a change in beliefs about how future returns depend on past realizations, holding constant beliefs about the unconditional average stock market return.

Final stage: Posterior beliefs After the information treatment, we elicit participants' agreement with verbal statements describing different patterns of autocorrelation of aggregate stock returns, which serve as manipulation checks. We then re-elicit respondents' expectations about the 12-month ahead return on the DAX, both as point forecast (as for the prior) and as a subjective probability distribution. Specifically, respondents assign probabilities to six brackets of potential return realizations, which are mutually exclusive and collectively exhaustive.[10]

At the end of the survey, participants complete a short advanced financial literacy test and answer a series of additional questions on how they acquire financial information, their experience in financial markets, their risk preferences, the frequency at which they trade financial securities, and their demographics.

2.2 Follow-up survey

To study the persistence of treatment effects, we invite respondents to a follow-up survey approximately four weeks after they completed the main survey. We choose a four-week gap between the two surveys to trade off between testing for persistence and maximizing the re-contact rate and therefore statistical power in the follow-up.

The follow-up survey starts with re-eliciting respondents' expectations about the 12-month ahead stock market return, in the form of both a point forecast and a subjective probability distribution. Subsequently, respondents again rate their agreement with the manipulation check questions describing different forms of autocorrelation of stock returns. To examine whether respondents recall the exact treatment information, we then re-elicit their beliefs about the historical average 12-month ahead returns for the six past return intervals. We use the same question format as for the elicitation of priors in the

[10]Respondents can only continue to the next screen if the probabilities entered sum to 100 percent.

main survey, which is illustrated in Panel A of Figure 1. In addition, we elicit respondents' perceived return over the 12 months before the follow-up.

Our prior before running the experiment was that changes in beliefs would fade quickly, as it is suggested by previous literature (Cavallo, Cruces and Perez-Truglia, 2017; Coibion, Gorodnichenko and Weber, 2021b; Haaland, Roth and Wohlfart, 2021; Roth and Wohlfart, 2020). To achieve a more persistent first-stage effect on respondents' beliefs, which we could then use to study the causal effect of beliefs on trading decisions, we therefore decided to use the follow-up survey to again present respondents in the treatment group with the information. We do so *after* the block of questions measuring persistence of changes in beliefs due to the initial intervention, and use the same treatment design as in the main survey. Participants in the control group again receive the information on the unconditional historical average annual return of the DAX. After that, we elicit respondents' agreement to two additional verbal statements describing patterns of autocorrelation of stock returns, and re-elicit their expectations about the 12-month ahead return of the DAX for a final time.

2.3 Institutional background and survey administration

We administered the survey to clients of a German online bank in September and October 2019. The bank is among the top five online banks in terms of market share in Germany as measured by the number of clients. The bank provides full bank services offering savings and credit products in addition to its brokerage entity, and is hence used as principal bank by many clients. In a different data collection based on the same sample selection procedure at the same bank, 71% of respondents state that the portfolio they hold with the bank is their main investment account. Clients at the bank trade financial securities online in a self-directed manner. The broker does not offer any financial advice to these clients. This is important as an intermediary would likely reduce the direct impact of an individual's subjective expectations on her choices.

We sent e-mail invitations to 14,000 individuals randomly selected from the bank's client pool. To eliminate deserted accounts, we only invited clients that had conducted at least one equity transaction with the broker over the previous 12 months. We offered invitees 10 EUR for completing the main survey and 5 EUR for the shorter follow-up. All payoffs were paid in the form of online shopping vouchers and distributed to participants

via e-mail.

Overall, 2,083 individuals completed the main survey. This corresponds to a comparatively high response rate of 14.9 percent. 80.9 percent of respondents agreed to be invited for a second survey when asked at the end of the main survey. 987 investors ultimately completed the follow-up, corresponding to a re-contact rate of 58.5 percent among those who got invited to the follow-up. At the median, recontacted respondents completed the follow-up 26 days after the main survey. The mean (median) response time was 22.1 minutes (17.8 minutes) for the main survey and 14.2 minutes (10.2 minutes) for the follow-up.

2.4 Data

Sample definition We take two steps to screen out participants who likely did not take the survey seriously or just quickly "clicked" through the questions to obtain the shopping voucher. First, we follow a similar procedure as Armona, Fuster and Zafar (2019) and drop respondents who in the main survey report prior or posterior point expectations about the return of the DAX over the 12 months after the survey lower than -20 percent or higher than 20 percent, roughly corresponding to the first and 98th percentiles of the response distributions. This step also ensures that our OLS estimates are not driven by outliers. Second, we drop participants who take less than 8 minutes or more than 60 minutes to complete the main survey. These steps leave us with 1,961 respondents in our baseline sample for the main survey, out of which 903 respondents form the follow-up sample.[11] Our results are robust to varying the cutoffs for distributions of point forecasts or for response time used to define the sample.

Sample characteristics Columns 2-6 of Table 1 display summary statistics of our sample. Column 1 shows population benchmarks from the 2017 wave of the Bundesbank's Panel of Household Finances (PHF), which is restricted to individuals participating in the stock market. Our respondents are predominantly male (84 percent vs 51 percent in the population). The average age is 45.2 years, slightly younger than the average investor in the population (50.6 years). Sample participants are relatively highly educated, with 54 percent holding a university degree (15 percent in the population). 77 percent

[11] The follow-up sample excludes participants who are not part of the baseline sample used in the main survey and those who report expectations in the follow-up survey outside the interval $[-20\%; 20\%]$.

are employed (65 percent in the population). Our respondents report an average net monthly household income of 3,914 EUR and a net household wealth of 300,488 EUR, fairly similar to the population. Participants have been investing in equity for 14.1 years on average at the time of the survey.

Administrative account data We obtain data on our respondents' month-end holdings and daily executed transactions of securities from December 2014 until March 2020 (including security identifiers, volume, and price). We merge information on the securities' asset classes and market prices from Thomson Reuters Datastream. Investors in our sample on average hold financial wealth of 55,272 EUR with the sample bank, of which 39,313 EUR are invested in equity (including direct holdings and holdings through mutual funds). Throughout our analysis, we focus on transactions in equity. On average, 45% of investors conduct at least one equity trade in a given month during the sample period. The average number of equity trades per month is 1.19. Figure A.1 shows the development of trading activity over the sample period.[12]

Selection into the survey We also use the administrative account data to examine which clients of the online bank select themselves into our survey. Unfortunately, we do not have administrative account data for all 14,000 clients who were invited to participate. However, we have access to a sample of 3,701 clients that were randomly selected from the bank's client pool based on the same criteria as the 14,000 invited clients (at least one equity transaction with the broker over the previous 12 months). Table A.1 compares our baseline sample with this random sample. As it is common in surveys, participation in our survey is correlated with investors' characteristics. Investors in our sample are less wealthy and trade less often compared to the average client at the bank. In addition, our respondents are somewhat younger and more likely to be male and to be employed. They are very similar to the random sample in terms of their equity share held at the bank and in terms of their risk attitude as measured by the bank.

[12]Throughout the analysis on the administrative account data, we set observations in the top percentiles of number of purchases and number of sales to missing. We also drop observations in the top percentiles of equity purchases and sales relative to total financial wealth, as such patterns may reflect abnormal trading patterns, e.g. due to investors shifting their portfolio away from the online bank. None of our findings are sensitive to the choices of cutoffs.

Integrity of the randomization Our sample is well-balanced between the treatment and the control group for a set of key demographic and financial characteristics as well as a set of pre-treatment beliefs (Table 1 Columns 7 and 8). There are a few exceptions, such as the level of education, which is slightly higher in the control group, and age, with is slightly higher in the treatment group. To rule out any concerns, we include a set of control variables in all our estimations.

3 Descriptive evidence

In this section we provide descriptive evidence on respondents' prior beliefs about the autocorrelation of stock returns and the correlation of these beliefs with investment choices.

3.1 Prior beliefs

3.1.1 Prior return perceptions and expectations

We start by documenting respondents' prior beliefs about aggregate returns over the 12 months before and the 12 months after the survey. While the return of the German stock market index over the 12 months preceding the survey averaged 1.1 percent during the field period, respondents on average believe that the stock market increased by 5.1 percent (median: 5 percent). Before receiving information, respondents expect a return of 3.2 percent over the 12 months following the survey on average (median: 4 percent). There is strong heterogeneity in respondents' beliefs about stock returns over the past 12 months and over the next 12 months (Figure A.2). Table 2 shows multivariate regressions of respondents' beliefs on a set of co-variates. Higher education is associated with lower and therefore more accurate return perceptions (Column 1). Higher education, financial literacy and trading experience are associated with lower expected returns (Column 2).

3.1.2 Prior perceived historical autocorrelation of aggregate returns

Next, we describe our respondents' prior beliefs about the historical autocorrelation of annual returns of the German stock market. Figure 2 Panel A shows respondents' mean estimates of the historical conditional average 12-month ahead returns of the DAX for the six past-return intervals in our belief elicitation task. On average, respondents believe that high returns tend to be followed by low returns and vice versa, consistent with a belief in mean reversion of aggregate returns. Specifically, respondents on average

estimate a mean year-ahead return of 13.5 percent for cases in which realized returns were in the lowest bin (less than -20 percent), and a mean year-ahead return of 3.8 percent for instances in which previous returns were in the highest bin (more than 20 percent). Over the intermediate intervals, respondents' average estimates of the historical mean 12-month ahead return monotonically decrease in the level of the previous 12-month return. Averaging over the six bins, respondents perceive a historical return of the DAX of 8.4 percent, almost identical to the actual unconditional historical average of 8.5 percent.[13]

The means conceal substantial heterogeneity in respondents' beliefs. Figure 2 Panel B displays box plots illustrating the distributions of respondents' estimates of the historical conditional mean 12-month-ahead returns for the six past-return intervals. Disagreement is highest for the two most extreme return bins. For instance, the interquartile range is three times as high for the highest bin (15 percentage points) as for moderately positive returns between 0 and 10 percent (5 percentage points).

We next study the perceived autocorrelation of aggregate returns at the individual level. First, we calculate the individual-specific standard deviation of each respondent's estimates of the 12-month ahead returns over the six past-return intervals (see Figure 2 Panel C for a histogram). This measure captures any form of perceived predictability of future returns based on recent returns, and should be close to zero for those perceiving no systematic relationship. On average respondents perceive a standard deviation of 7.1 percentage points over the six intervals (median: 6.4 percentage points), while the standard deviation is 0.8 percentage points based on the true historical values. For part of the remaining analysis we classify investors as perceiving a high or a low degree of predictability based on previous returns by splitting the sample at the median of the individual-level perceived standard deviation.

Second, we calculate the individual-specific difference between a respondent's average estimated year-ahead return across the three intervals of positive previous-year returns and the respondents' average estimate for the three negative previous return intervals. As shown in Figure 2 Panel D, the majority of our respondents (70.5 percent) believe that returns over the following year were systematically higher when returns in the previous year were negative than when they were positive. Thus, a belief in mean reversion seems

[13]If we reweight the six bins by their historical relative frequency, the average perceived unconditional return is slightly lower at 7.2 percent.

to be most common among the investors in our sample. We classify investors as "mean reverters" if the difference in average estimated returns for the following year between positive and negative previous return scenarios is lower than -4 percentage points (52.5 percent of our sample), as "neutral" if this differences lies between -4 and 4 percentage points (31.9 percent), and as "extrapolators" if it is greater than 4 percentage points (15.6 percent). None of our findings are sensitive to the exact choice of cutoffs, as we demonstrate for our main results throughout the paper. Importantly, by classifying types according to their perceived *difference* across bins, we abstract from differences in the perceived average *level* of historical returns across respondents.

How are the different types distributed across the population? Table 2 Column 4 regresses the individual-level standard deviation across the six scenarios on a set of covariates. Higher education, investment experience and attention to the DAX are associated with a higher perceived standard deviation, while older respondents perceive a lower predictability. The patterns are similar if we use the dummy for perceiving a standard deviation above the sample median as outcome (Column 5). Columns 6-9 focus on the perceived difference in year-ahead returns between positive and negative previous returns as well as dummies for being a mean reverter, neutral, or an extrapolator. Women tend to hold extrapolative beliefs, while men tend to believe in mean reversion. Older investors are more likely to be in the neutral category. Higher education and financial literacy, higher financial wealth, higher investment experience and higher attention to the DAX are associated with a stronger belief that past developments will be reverted in the future. Given the historical low degree of predictive power of previous year's returns for returns over the next year, it is striking that beliefs in mean reversion are particularly prevalent among more sophisticated, experienced and attentive individuals with high stakes due to high levels of financial wealth.[14,15]

[14]These patterns are not driven by lower attention to our survey among less sophisticated investors, which may result in respondents indicating the same number across the six scenarios. Only 1.1 percent of respondents enter a constant number across the six intervals. Moreover, the patterns presented in Table 2 remain very similar if we exclude those respondents, or if we control for response time or for passing an attention screener.

[15]Table A.2 shows summary statistics across different belief types, which strongly confirm the patterns from the multivariate regressions shown in Table 2.

3.1.3 Perceived autocorrelation and return expectations

Do investors' beliefs about the historical autocorrelation of aggregate returns predict their return expectations at the time of our survey? We first select the past-return interval covering respondents' perceived return over the 12 months before the survey.[16] We then study the correlation between the respondent's belief about the historical mean year-ahead return in that scenario and the respondent's actual expected return for the 12 months after the survey. Figure A.4 Panel A displays a binned scatterplot of this relationship that partials out a set of controls that is used throughout the paper.[17] A one percentage point higher perceived return in the relevant historical scenario is associated with a 0.134 percentage points higher expected return at the time of the survey, and the relationship is highly statistically significant ($p<0.01$).[18]

Taken together, our first main result is the following:

Result 1. *There is substantial heterogeneity in retail investors' beliefs about the autocorrelation of aggregate stock returns. A majority of investors believe that historically returns of the German stock market mean-reverted. Beliefs in mean reversion are more prevalent among more sophisticated, attentive, experienced, and wealthy investors, and among men. Respondents' perceived historical autocorrelation has strong predictive power for their expected returns over the 12 months after the survey.*

These findings suggest that heterogeneity in investors' subjective models of the stock market contributes to the empirically documented disagreement in stock return expectations across investors (Giglio, Maggiori, Stroebel and Utkus, 2021a).

3.1.4 Discussion

How do our respondents' prior beliefs about the autocorrelation of stock returns relate to findings in previous literature? Several studies document that households on average extrapolate recent past developments of home price growth (Armona, Fuster and

[16] Figure A.3 shows a binned scatter plot of respondents' perceived return over the 12 months before the survey against the actual realization until the day before the respondent took the survey. Differences in realized returns over the two-months survey period are strongly reflected in respondents' perceptions.

[17] We include a set of demographics, survey measures of investor behavior such as trading experience and risk tolerance, measures of the respondent's holdings with the bank such as the equity share, and controls for technical issues such as taking the survey on a mobile phone. The exact definition of the control variables is provided in Appendix A.

[18] We find a slightly stronger relationship if we use the actual return realization over the 12 months before a respondent took the survey (instead of the respondent's perception) to select the relevant historical return interval (Figure A.4 Panel B).

Zafar, 2019; Kuchler and Zafar, 2019), inflation (Malmendier and Nagel, 2016) or stock returns (Adam, Marcet and Beutel, 2017; Greenwood and Shleifer, 2014; Vissing-Jorgensen, 2003). While our finding of prevalence of beliefs in mean reversion contrasts with these results, several prior studies suggest that beliefs in persistence are less common in the context of stock returns than in other contexts, such as the housing market (Armona, Fuster and Zafar, 2019). For instance, Dominitz and Manski (2011) document that while 41 percent of US households form return expectations in line with a belief in persistence, beliefs in mean reversion are also quite prevalent with 32 percent. Heiss, Hurd, van Rooij, Rossmann and Winter (2019) find that beliefs in persistence and mean reversion are equally prevalent in a survey of Dutch households (about 20 percent for each). Moreover, several studies document that retail investors exhibit contrarian trading behavior around earnings surprises (Grinblatt and Keloharju, 2000, 2001; Luo, Ravina, Sammon and Viceira, 2020), consistent with a belief in mean reversion of individual stock returns.

Our setup differs from previous literature in several ways. Most importantly, most other studies are based on the development of expected returns following different market realizations of returns, while we elicit respondents' perceived autocorrelation directly. This has a number of implications. First, return realizations are correlated with other macroeconomic developments such as overall GDP growth, which may affect subjective return expectations (Amromin and Sharpe, 2013; Giglio, Maggiori, Stroebel and Utkus, 2021a). In our elicitation, the only thing respondents observe for each scenario is the previous return realization. Second, large fractions of investors will be inattentive to market movements at any point in time, while in our survey every respondent observes the different hypothetical scenarios of realized returns. Third, while we measure respondents' active knowledge of the historical autocorrelation of returns, we do not capture extrapolation that may occur on a subconscious basis. Beyond the different measurement, evidence in previous literature is often based on general household surveys. By contrast, we focus on a group of investors that actively trade stocks and have comparatively high levels of financial knowledge. Within our sample, beliefs about return persistence strongly vary with measures of sophistication and financial wealth, suggesting heterogeneity in perceived models across different groups of the population.

3.2 Correlational evidence on beliefs and investment choices

In this section we examine how investors' prior beliefs about the historical autocorrelation of stock returns are correlated with their portfolio decisions as measured in the administrative account data. For this analysis, we make use of the entire history of transactions and security holdings of survey respondents with the broker since December 2014, i.e. a period of almost five years preceding the survey. We include control group respondents until the end of January 2020, while investors in the treatment group are only part of the sample until the month before they took the survey (between September and November 2019).[19]

We start by examining whether investors' beliefs about the autocorrelation of stock returns affect the timing of their trading decisions. Specifically, we test whether different belief types respond differently to downturns of the stock market as measured by the return over the previous 12 months. Figure A.5 in the appendix depicts the returns of the DAX over the previous 12 months for each month in our sample period.

We estimate specifications of the following form:

$$\begin{aligned} Y_{i,t} = \alpha_0 &+ \alpha_1 \text{DAXdown}_t \times \text{Extrapolator}_i + \alpha_2 \text{DAXdown}_t \times \text{Neutral}_i \\ &+ \alpha_3 \log(\text{Financial wealth})_{i,t-1} + \mu_i + \mu_t + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where $Y_{i,t}$ is a measure of respondent i's trading activity during month t. DAXdown_t is an indicator whether the return of the DAX over the previous 12 months has been negative. Extrapolator_i and Neutral_i are dummies indicating whether the investor's perceived difference of historical year-ahead returns between positive and negative previous returns is at least 4 p.p. or between -4 p.p. and 4 p.p., respectively, as defined in Section 3.1.2. Mean reverters are the omitted base group. We also include lagged log financial wealth held with the bank, $\log(\text{Financial wealth})_{i,t-1}$, month-year fixed effects, μ_t, as well as investor fixed effects, μ_i, which control for time-invariant differences in trading activity across different types of investors. We report standard errors that are two-way clustered by investor and time period.

Panel A of Table 3 presents the results for the full sample. The dependent variables

[19] We obtain very similar results if we also exclude control group respondents beginning in the month they took the survey, or if we include them until the end of March 2020, which includes the COVID-19 stock market crash. We analyze trading responses to the crash separately in Section 4.2.

in Columns 1 through 3 capture the frequency and volume of investors' buying decisions. Compared to mean reverters, extrapolators exhibit a 2.7 percentage points lower probability of making any equity purchase in response to negative returns of the DAX conditional on permanent differences across groups (Column 1 of Panel A, $p < 0.05$). This effect is sizable, given that on average 39.5 percent of investors conduct at least one equity purchase in a given month. Moreover, relative to mean reverters, and relative to times of positive realized returns, extrapolators conduct 0.1 fewer equity purchases (Column 2 of Panel A, $p < 0.05$, compared to an average number of 1) and exhibit a 0.185 smaller log equity purchase volume (Column 3 of Panel A, $p < 0.05$, compared to an average log volume of 2.4) when returns have been negative.[20] The estimated coefficients remain very similar when we exclude investors that we observe for only half of our sample period or less, for whom the available variation in stock market returns is more limited (Panel B). Moreover, the estimated effects increase in size and statistical significance when we focus on a sample of active investors, which excludes the lowest quartile in terms of the number of trades executed in the twelve months prior to the observation month (Panel C). Panel D estimates the differential adjustment of mean reverters to negative returns compared to the pooled group of neutrals and extrapolators, which increases precision of the coefficient estimates. We find no differential adjustments in selling decisions when stock returns are negative across belief types (Columns 4 to 6). This is in line with the idea that buying decisions tend to be more forward-looking than selling decisions, which may mostly be driven by other considerations (Barber and Odean, 2013). Finally, the differential responses to stock market downturns are reflected in differences in the net log buying volume, which are more noisily measured when focusing on the small group of extrapolators (Column 7).[21]

Moreover, we examine whether beliefs about the autocorrelation of stock returns are reflected in fluctuations of the equity share of investors' holdings with the bank. In Column 1 of Table 4 we report estimations of equation 1 using the equity share in the respondent's total financial wealth as outcome. Panel A focuses on the full sample, Panel B excludes those with short observation periods and Panel C focuses on active investors.

[20] We add the value one to the purchase and the sales volume before taking logs to include observations with a volume of zero.

[21] Table A.3 demonstrates robustness of the differential adjustment to stock market downturns across belief types to using different cutoffs of the perceived gain-loss difference to define mean reverters, neutrals and extrapolators.

Conditional on permanent differences in equity shares across belief types (accounted for by the individual fixed effects), and conditional on changes in the equity share that are common across types (controlled for by the time fixed effects), extrapolators hold a 2.4 percentage points lower equity share than mean reverters when the stock market return was negative over the previous twelve months, which is stable across samples ($p < 0.01$ or $p < 0.05$). The magnitude of these within-investor fluctuations in the equity share is substantial, given an average within-investor standard deviation of the equity share over the sample period of 12.9 percentage points when focusing on the full sample from Panel A. Column 2 demonstrates qualitatively similar results when comparing adjustments of the equity share between mean reverters and the pooled group of extrapolators and neutrals.

We also use the respondents' beliefs elicited across the six historical realized return scenarios and the actual return over the previous twelve months to more directly predict a respondent's expected return at any given point in time in our sample period. In Column 3 of Table 4 we report pooled OLS estimates of the relationship between the equity share of a respondent's total financial wealth with the bank and the return that the respondent would expect based on this prediction, conditional on a set of controls. A one percentage point higher predicted expected return is associated with a between 0.1 and 0.2 percentage points higher equity share ($p < 0.05$ or $p < 0.1$ depending on the sample). This relationship also holds if we control for the respondent's unconditional average perceived return across the six historical scenarios (Column 4) or if we include investor fixed effects (Column 5), although the effect size and significance are reduced in the last case. This implies that the effects of expected returns as predicted by the respondents' beliefs about historical return realizations are not purely driven by differences in perceived unconditional average historical returns across investors. Respondents' beliefs about whether a given return realization is associated with above- or below-average returns over the following year seem to matter for their portfolio decisions.

The association of predicted return expectations with the equity share in our data is substantially smaller than theory benchmarks, similarly as documented by Giglio, Maggiori, Stroebel and Utkus (2021a) for Vanguard clients in the US. Our estimates of the effect of expected returns on the equity share of 0.1 to 0.2 are even smaller than their estimates reaching from 0.7 to 1.2 depending on the specification. In Appendix B we

show that, once we adjust for the fact that we predict investors' expectations depending on their beliefs about the historical autocorrelation of aggregate returns and depending on realized returns over the previous 12 months, we obtain a relationship of remarkably similar magnitude as estimated by Giglio, Maggiori, Stroebel and Utkus (2021a).

Our second main result is the following:

Result 2. *Respondents' beliefs about the autocorrelation of stock market returns elicited in the survey match the timing of their equity transactions before the intervention. Mean reverters are significantly more likely to purchase equity in response to negative stock market returns compared to extrapolators. Furthermore, beliefs about the autocorrelation of aggregate returns also play a role in retail investors' portfolio composition as measured by the equity share.*

These findings validate our main survey measure, and provide correlational evidence that heterogeneity in subjective models of the stock market is reflected in differences in trading decisions across groups of investors.

4 Experimental evidence

4.1 Updating of beliefs

In this section we describe how respondents change their beliefs about the autocorrelation of aggregate returns and about the 12-month-ahead return in response to the information.

4.1.1 Manipulation check

We start by examining whether the information treatment changes respondents' beliefs about the autocorrelation of aggregate stock returns. After the treatment, we ask respondents to rate their agreement with three verbal statements capturing different beliefs about how informative recent past returns are about year-ahead returns on 7-point scales. Table 5 reports OLS estimates of the effect of the information treatment on respondents' agreement with these statements (z-scored using the mean and standard deviation in the sample), including the same set of controls as previously. We also report specifications in which the treatment indicator is interacted with dummies for groups who report different prior beliefs for the historical return intervals. We report robust standard errors for all estimations of treatment effects on respondents' beliefs.

First, the treatment significantly increases agreement with the statement *"With an investment in stocks one can expect a positive return, independently of how the stock market has developed in the recent past."* by 9.3 percent of a standard deviation in the full sample (Column 1, $p < 0.05$). In the control group, those respondents who perceive a higher standard deviation over the six return intervals before the intervention (indicating a higher perceived informativeness of recent for future returns), agree less with this statement (Column 2, $p < 0.10$). In line with this difference, the increase in agreement among treated respondents is fully driven by those with a higher prior perceived standard deviation (Column 2, $p < 0.01$).

Second, the treatment does not significantly change respondents' agreement that *"When the stock market has recently increased it makes no sense to buy stocks"* in the full sample (Column 3). However, those who believe in mean reversion before the intervention reduce their agreement by 15.5 percent of a standard deviation in response to the information (Column 4, $p < 0.01$). This implies that the treatment fully offsets the higher baseline agreement among mean reverters compared to neutrals to this statement, as indicated by the difference in the control group (Column 4, $p < 0.05$).

Third, treated respondents agree 14.7 percent of a standard deviation less that *"When the stock market has recently increased it is more likely that stock returns will be positive over the following time than when the stock market has recently decreased."* (Column 5, $p < 0.01$). In the control group, extrapolators exhibit significantly higher baseline agreement to this statement than neutrals (Column 6, $p < 0.01$). In line with this difference, the decrease in agreement in response to the information is significantly stronger for extrapolators than for neutrals or mean reverters (Column 6, p-values of these differences$<$0.05).

We find similar patterns of average and heterogeneous treatment effects using two additional statements that were included after treated respondents were shown the information for a second time in the follow-up survey (Column 7-10).

Taken together, these results indicate that the treatment substantially reduces beliefs of return predictability based on recent returns among respondents, and it does so differentially and in the expected directions across groups with different prior beliefs.[22]

[22]Table A.4 demonstrates robustness of the estimations by group in Columns 4, 6, 8 and 10 of Table 5 to using different cutoffs of the perceived gain-loss difference to define mean reverters, neutrals and extrapolators.

Thus, our treatment seems to successfully change our respondents' subjective model of the aggregate stock market.

4.1.2 Updating of return expectations

We next turn to respondents' updating of their expected return of the German stock market over the 12 months after the survey in response to the information. Depending on i) respondents' prior beliefs about the return over the 12 months *before* the survey, and ii) respondents' prior beliefs about the historical autocorrelation of aggregate returns, our treatment implies an information shock that should be relevant for respondents' expectations about the return over the 12 months after the survey.

We define a respondent's perception gap as follows: First, out of the six intervals of realized returns we select the one into which the respondent's perceived realized return over the 12 months before the survey falls, interval(Perceived ret 12m before survey$_i$). Second, we calculate the difference between the actual historical conditional mean 12 months ahead return for the relevant interval and the respondent's corresponding prior:

$$\begin{aligned}&\text{Perception gap}_i\\ =&\text{Actual hist 12m ahead ret[interval(Perceived ret 12m before survey}_i\text{)]}\\ -&\text{Prior perceived hist 12m ahead ret}_i\text{[interval(Perceived ret 12m before survey}_i\text{)]}\end{aligned} \quad (2)$$

If respondents form their return expectations at least partially based on their beliefs about the historical autocorrelation, a larger perception gap should lead to a stronger updating of expectations about the return over the 12 months after the survey among respondents in the treatment group. We estimate specifications of the following form:

$$\begin{aligned}\text{Updating}_i = \alpha_0 &+ \alpha_1 \text{Perception gap}_i \times \text{Treatment}_i\\ &+ \alpha_2 \text{Perception gap}_i + \alpha_3 \text{Treatment}_i + \varepsilon_i\end{aligned} \quad (3)$$

where Updating$_i$ is the difference between a respondent's posterior and prior beliefs about the return over the 12 months after the survey.[23] Our main coefficient of interest is α_1, which captures treatment effects to the extent that they are proportional to a respondent's perception gap. α_2 captures differential changes in reported expectations across

[23] As explained in Section 2.4, we drop participants who report prior or posterior expectations lower than -20 or higher than 20 percent, which should reduce the influence of outliers to a large extent. To account for the few remaining outliers, we winsorize both perception gap and updating variables at -20 and 20 percent. None of our findings are sensitive to the exact choice of cutoffs.

respondents with different perception gaps independently of the treatment, while α_3 captures any updating in response to the treatment that is independent of the perception gap.

Table 6 presents the results. Column 1 shows a simple OLS estimation. In Column 2 we instrument the perception gap and the interaction term, which are calculated based on the respondents' subjective return perception over the last 12 months, with versions of the gap and the interaction term that are based on the actual realized return over the 12 months before taking the survey (which varies over the survey period), in order to mitigate attenuation bias due to measurement error in subjective beliefs. Columns 3 and 4 show OLS and IV estimations in which the posterior is based on the mean of the respondent-level subjective distribution over 12 month-ahead returns instead of the point belief. Based on these specifications we estimate coefficients between 8.6 percent and 14.2 percent on the interaction term, which are significant at the 1 percent or at the 5 percent level. These experimental estimates of the effect of predicted return expectations based on the perceived autocorrelation on actual return expectations are very close to the correlational estimate based on respondents' priors of 0.13 (see Figure A.4 Panel A). Our estimated learning rates are within the range of estimates from previous information provision experiments on macroeconomic expectation formation (Armona, Fuster and Zafar, 2019; Cavallo, Cruces and Perez-Truglia, 2017; Coibion, Gorodnichenko and Weber, 2021b; Haaland, Roth and Wohlfart, 2021; Roth and Wohlfart, 2020). We also find some updating in response to the treatment that is independent of a respondent's perception gap, which could be due to salience effects or priming. Overall, the change in our respondent's subjective model of the stock market causes our respondents to update their 12-month ahead return expectations in the expected direction.

We also find a decline in disagreement about 12-month ahead returns in response to the treatment. The difference between the 90th and the 10th percentile across respondents' posterior point forecasts is 15 percentage points in the control group and 10.6 percentage points in the treatment group. Thus, greater agreement about the model of the stock market causes a decline in the dispersion of return expectations.

4.1.3 Persistence in four-week follow-up

How persistent are changes in beliefs in response to the treatment information? We address this question using data from the follow-up survey in which respondents partic-

ipated about four weeks after the main survey. We focus on responses in the follow-up that were given *before* the information was provided for a second time to respondents in the treatment group.

First, we examine respondents' beliefs about historical 12 months-ahead returns for the six intervals of realized returns over the previous 12 months. For each interval we regress the difference between a respondent's follow-up and prior beliefs on the gap between the information and the respondent's prior, a treatment dummy, and the interaction of the two. Table A.5 Columns 1-6 highlight estimated coefficients on the interaction term of about 0.25, indicating that treated respondents adjust their beliefs by about one fourth of the initial gap to the information. We find similar effects for the perceived standard deviation over the six intervals and the perceived difference between positive and negative returns over the previous year (Columns 7-8).

Second, Table A.6 examines agreement to the three verbal manipulation check questions in the follow-up. Since these questions were included in both the main and the follow-up survey, we can quantify the persistence of initial treatment effects. For both the statement capturing beliefs about the absence of any form of predictability and the statement capturing a belief in mean reversion, we find that treatment effects strongly persist, and, if anything, increase in size compared to the main survey. While the treatment effects on agreement to the statement capturing a belief in persistence do not persist, this finding should be interpreted in light of the very small group of prior extrapolators in the follow-up sample.

Third, Columns 5-8 in Table 6 examine persistence of updating of expectations about the return over the 12 months after the survey. For these specifications we calculate the perception gap based on the respondent's perceived return over the 12 months before the follow-up. In both OLS and IV specifications the estimated effect sizes *increase* compared to the effect sizes in the main survey.

Taken together, these patterns highlight a strong persistence of treatment effects on respondents' beliefs. Previous studies often find that treatment effects on respondents' beliefs persist at a reduced size in follow-up surveys (Armona, Fuster and Zafar, 2019; Cavallo, Cruces and Perez-Truglia, 2017; Coibion, Gorodnichenko and Weber, 2021b; Roth and Wohlfart, 2020). The higher persistence in our setting could be due to the fact that our information treatment aims to change respondents' beliefs about the data gen-

erating process instead of providing them with information that might lose its relevance over time, such as e.g. expert forecasts.

Our evidence on persistence also mitigates two concerns. First, changes in return expectations could be driven by unconscious numerical anchoring on the information. Such anchoring is a short-lived phenomenon by definition, so the strong persistence of treatment effects in the follow-up suggests a limited role for numerical anchoring (Cavallo, Cruces and Perez-Truglia, 2017). Second, experimenter demand effects – respondents guessing the experimental hypothesis and trying to conform with it – should be less important in the follow-up (Haaland, Roth and Wohlfart, 2021).[24]

Taken together, our third main result is the following:

Result 3. *Our de-biasing intervention persistently removes notions of return predictability based on recent returns among our respondents. Moreover, respondents significantly adjust their expectations about returns over the 12 months after the survey in response to the information, which results in a reduction in disagreement in expectations. This provides causal evidence that heterogeneity in subjective models of the stock market is a causal driver of disagreement in stock return expectations among retail investors.*

4.2 Changes in investment behavior

Finally, we investigate whether changes in investors' subjective models of the stock market in response to the treatment affect their future trading behavior. For this analysis, we make use of transaction data until including March 2020, which means that we observe respondents' behavior until five to six months after the intervention. This period provides a unique setup to examine effects of beliefs about the autocorrelation of returns on trading decisions, as it includes the stock market crash in February and March 2020, which was triggered by the COVID-19 pandemic. Specifically, the German stock market dropped by about 30 percent between mid-February and mid-March. Depending on a respondent's prior beliefs, we would expect our intervention to lead to changes in the respondent's trading decisions during the crash. We focus on the same outcome variables as in our correlational analysis on beliefs and investment choices in Section 3.2. To increase power, we study treatment effects on the group of mean reverters and on the group of non-mean reverters, which includes both neutrals and extrapolators, giving us two groups of

[24]de Quidt, Haushofer and Roth (2018) show that demand effects seem to be of limited quantitative importance in online experiments.

roughly equal size. As before, our results are not sensitive to the exact cutoffs used to define groups. However, they become more noisily estimated when we focus on smaller groups.

We start by describing trading behavior during the crash among respondents in the control group. To understand how, among the non-treated, mean reverters differentially adjust their trading behavior in response to the COVID-19 crash compared to non-mean reverters, we estimate specifications of the following form, using the full sample period from December 2014 until March 2020:

$$\begin{aligned} Y_{i,t} = \alpha_0 &+ \alpha_1 \text{COVID-19}_t \times \text{post}_{i,t} \times \text{Mean reverter}_i + \alpha_2 \text{post}_{i,t} \times \text{Mean reverter}_i \\ &+ \sum_{s=1}^{9} \beta_s \text{pre-period s}_{i,t} \times \text{Mean reverter}_i + \gamma \text{post}_{i,t} + \sum_{s=1}^{9} \delta_s \text{pre-period s}_{i,t} \\ &+ \eta \log(\text{Fin. wealth})_{i,t-1} + \mu_i + \mu_t + \varepsilon_{i,t} \end{aligned} \tag{4}$$

where $Y_{i,t}$ is a measure of respondent i's trading activity during month t. COVID-19_t is an indicator for February and March 2020 – the time of the COVID-19 downturn of the stock market. $\text{post}_{i,t}$ is an indicator for all months from (including) the survey month (September, October or November 2019) until including March 2020. To make the specification comparable to specification 5 below analyzing treatment effects, we also include interactions of dummies for six-months intervals for the time before our survey with a dummy for mean reverters. The period directly preceding the survey (months -6 until -1) is omitted. All specifications control for individual fixed effects, μ_i, month-year fixed effects, μ_t, as well as lagged log financial wealth, $\log(\text{Fin. wealth})_{i,t-1}$. The coefficient α_1 captures how mean reverters differentially adjust their trading decisions from the preceding months to the COVID-19 shock compared to non-mean reverters. The period including the survey but before the crash featured relatively high realized 12-month aggregate returns of 10.77 percent on average (25.42 percent in January 2020). α_2 captures the differential change in trading of mean reverters from the 6 months preceding the survey, featuring somewhat negative 12 month-returns of -3.06 percent, to the period including the survey but before the crash. We cluster standard errors by investor and trading month.

Table 7 Panel A presents the results on trading adjustments in the control group,

focusing on the sample of active investors.[25] Mean reverters increase their buying significantly more strongly in response to the crash than non-mean reverters, consistent with a relative upward adjustment in their expectations in response to the shock. Specifically, mean reverters display a significantly stronger increase in the number of overall buys (Column 2, $p < 0.05$) compared to non-mean reverters. The estimated coefficients for the probability to buy (Column 1, $p = 0.126$) and the logged buying volume (Column 3, $p = 0.110$) are also positive, but more noisily measured. We also find relative increases in equity sales in response to the crash among mean reverters (Table 7 Columns 4-6), but the magnitudes of these effects are mostly much smaller than for buying decisions, such that they still result in a noisily measured relative increase in the net log buying volume (Column 7). Thus, differences across groups of investors in the perceived historical autocorrelation of returns are reflected in a differential development of trading activity during the crash.

Figure A.6 plots the coefficients on the monthly time fixed effects included in specification 4, where August 2020 is omitted, which highlight the development of trading activity among the base group of non-mean reverters in the control group. As can be seen, the COVID-19 crash is associated with an increase in buying activity also among non-mean reverters (even though the increase is smaller than for mean reverters). Potential drivers of the increase in buying activity even among non-mean reverters include i) that expected returns are only partially driven by beliefs about the historical autocorrelation of returns (see Figure A.4) — i.e. people believing that the COVID-19 crash is different than other downturns, and ii) that buying decisions may partially be affected by motives other than changes in expected returns, such as e.g. rebalancing motives.[26]

We next turn to the effect of our intervention on respondents' trading behavior. We estimate the following investor-month level specification separately for mean reverters and non-mean reverters:

[25]The results are qualitatively similar but more noisily measured in the full sample, as shown in Appendix Table A.7.

[26]Other studies point to significant heterogeneity of investors' trading responses to the COVID-19 crash across groups. Giglio, Maggiori, Stroebel and Utkus (2021b) find that wealthy Vanguard clients on average reduced their equity holdings in response to the crash. Welch (2021) and Ortmann, Pelster and Wengerek (2020) document increases in buying activity among retail investors in response to the crash. In our paper, we focus on *differential* changes in trading activity between mean reverters and non-mean reverters, as well as treatment effects of our information intervention on the relative behavior of these groups.

$$
\begin{aligned}
Y_{i,t} = \alpha_0 &+ \alpha_1 \text{COVID-19}_t \times \text{post}_{i,t} \times \text{treatment}_i + \alpha_2 \text{post}_{i,t} \times \text{treatment}_i \\
&+ \sum_{s=1}^{9} \beta_s \text{pre-period s}_{i,t} \times \text{treatment}_i + \gamma \text{post}_{i,t} + \sum_{s=1}^{9} \delta_s \text{pre-period s}_{i,t} \\
&+ \eta \log(\text{Fin. wealth})_{i,t-1} + \mu_i + \mu_t + \varepsilon_{i,t} \qquad (5)
\end{aligned}
$$

where treatment_i is an indicator equal to one if a respondent belongs to the group receiving the de-biasing treatment. The inclusion of interaction terms between dummies for six-month-pre-periods allows us to examine whether treated and non-treated respondents were on similar trends before the treatment. Here, the coefficient α_1 captures how treated respondents differentially adjust their trading decisions from the preceding months to the COVID-19 shock compared to non-treated respondents. α_2 captures treatment effects on trading decisions in the time including the survey month until just before the crash.[27]

Panel B of Table 7 displays estimated treatment effects among those believing in mean reversion before our intervention. Experimentally induced changes in beliefs only cause minor adjustments in respondents' purchasing behavior over the first months after the survey. However, treated mean reverters display a significantly smaller increase in their probability to buy (Column 1, $p < 0.05$), a smaller increase in the overall number of buys (Column 2, $p < 0.01$) and a lower increase in the log buying volume (Column 3, $p < 0.05$) than non-treated mean reverters in response to the crash. The treatment also somewhat reduces the number of sales among mean reverters (Columns 4-6). Together, the effects still result in a reduction of the net log buying volume (Column 7), although this effect is noisily measured. Figure 3 displays the implied treatment effects on the number of buys (Panel A) and the log buying volume (Panel B) among mean reverters by period. The figure highlights the insignificant treatment effects in the first months after the intervention, and the significant effects on respondents' reactions to the COVID-19 shock. The figure also illustrates that there are no differential pre-trends in the trading decisions of treated and non-treated respondents before the intervention.[28]

[27] We control for lagged log financial wealth to make the results comparable to specification 4 and the correlational evidence presented in Table 3. Our results hardly change if we exclude financial wealth, which may be affected by the treatment and therefore be a "bad control".

[28] Table A.8 demonstrates robustness of the treatment effects on the trading behavior of mean reverters to using different cutoffs of the perceived gain-loss difference to define this group.

Our treatment closes the control-group gap in the reaction to the shock between mean reverters and non-mean reverters (see Table 7 Panel A) by between 65 and about 100 percent across outcomes. Indeed, treated mean reverters are no longer statistically distinguishable from non-treated non-mean reverters. Thus, our information treatment causes substantial adjustments in investors' trading decisions four to five months after the intervention as measured in administrative account data, in line with a persistent change in respondents' perceived model of the stock market.

Panel C of Table 7 shows our estimated treatment effects for respondents that are not classified as mean reverters (neutrals and extrapolators). Consistent with the smaller average implied change in expectations caused by the treatment within this group, we find no strong adjustments in trading decisions in response to the treatment among non-mean reverters, even though estimated treatment effects go – as expected – in most cases in the opposite direction compared to mean reverters. We lack the power to study adjustments in behavior for neutrals and extrapolators separately.[29]

Our final result is the following:

Result 4. *Changes in beliefs about the autocorrelation of aggregate returns induced by the experimental intervention significantly reduce equity purchases during the COVID-19 crash among those who believe in mean reversion of aggregate returns before the intervention. This highlights that respondents' subjective model of the stock market causally shapes their trading decisions.*

Did the treatment intervention improve respondents' investment outcomes? Given the strong recovery of the stock market from around mid-April, de-biased mean reverters, who increased their stock purchases less during the crash, may eventually have performed worse than mean reverters in the control group.[30] However, given that we only observe one realization of aggregate stock returns, this difference in *ex-post* outcomes is not adequate to assess the quality of their investment decisions from an *ex-ante* perspective. Indeed, as indicated by our information treatment, historically, downturns of the stock market

[29]In unreported regressions we also studied potential short-term adjustments (within four weeks after the treatment) in investment decisions proportional to respondents' perception gap based on specifications similar to equation 3. In line with the results reported in Table 7, we found no evidence of systematic short-term adjustments in investment decisions in response to the intervention based on those specifications.

[30]Since our account data only reaches until the end of March, we cannot study investment outcomes beyond the time of the crash.

had not been systematically associated with higher returns over the next 12 months.

5 Implications and conclusion

We study individuals' perceived models of the stock market and the causal effect of these models on their investment decisions using an information provision experiment on a sample of retail investors at a German online bank. There is substantial heterogeneity in households' beliefs about the autocorrelation of aggregate stock returns. Prior to our intervention, a majority of investors believe in mean reversion of aggregate returns, i.e. that high returns tend to be followed by low returns and vice versa. Beliefs about the autocorrelation of returns are significantly related to the timing of investors' trading decisions and changes in their equity share over the five years before the intervention. Our respondents significantly update their beliefs in response to information about the historically low degree of predictability of the stock market based on recent returns. While there are no strong adjustments in trading decisions in the short-term, treated respondents believing in mean reversion before the intervention increase their equity purchases significantly less in response to the COVID-19 crash four to five months after the intervention, consistent with the change in their subjective model caused by the information.

We add to recent evidence on heterogeneity in individuals' beliefs about the functioning of the economy and asset markets (Adam, Marcet and Beutel, 2017; Andre, Pizzinelli, Roth and Wohlfart, 2021; Armona, Fuster and Zafar, 2019). Such heterogeneity offers an alternative to information frictions as an explanation for the widely documented disagreement in expectations about macroeconomic outcomes. Our findings suggest that heterogeneity in subjective models of the stock market contributes to the disagreement in expected returns across households detected in previous literature (Giglio, Maggiori, Stroebel and Utkus, 2021a). Most importantly, our results highlight how individuals' perceived models causally shape their investment decisions. Taken together, our findings support theories in which trade in asset markets occurs because agents relying on heterogeneous models arrive at different expectations about the future even when they observe the same new piece of information (Harrison and Kreps, 1978; Scheinkman and Xiong, 2003). At a more general level, our evidence suggests that heterogeneity in subjective models leads to differences in economic decisions across groups, and points to the

importance of accounting for such heterogeneity in theoretical and empirical research in macroeconomics and finance.

Future research should try to better understand the sources of heterogeneity in perceived models, such as differences in personal experiences or knowledge of economics (Andre, Pizzinelli, Roth and Wohlfart, 2021). Related to this point, our finding that individuals' subjective models are highly elastic to new information suggests that agents form these models based on a limited number of data points. Moreover, future literature should study the causal effect of individuals' beliefs about economic relationships on their decisions in other contexts. For instance, individuals' perceived models could matter for their consumption responses to fiscal and monetary policy measures. Our approach, which combines elicitation of beliefs under different scenarios with a de-biasing intervention and administrative data on decisions, provides a widely applicable method to pursue these research questions.

Finally, our results have important implications for understanding household financial decision-making. Even though our sample consists of relatively experienced, financially literate, active and wealthy retail investors, biased beliefs about the time series properties of aggregate returns are prevalent, and in fact more common among those who are more sophisticated. This suggests that biases in beliefs about the functioning of financial markets are unlikely to go away once households become more experienced participants in these markets. At the same time, our results suggest that low-cost information interventions can be an effective tool to correct these biases and have the potential to change households' decision-making months later.

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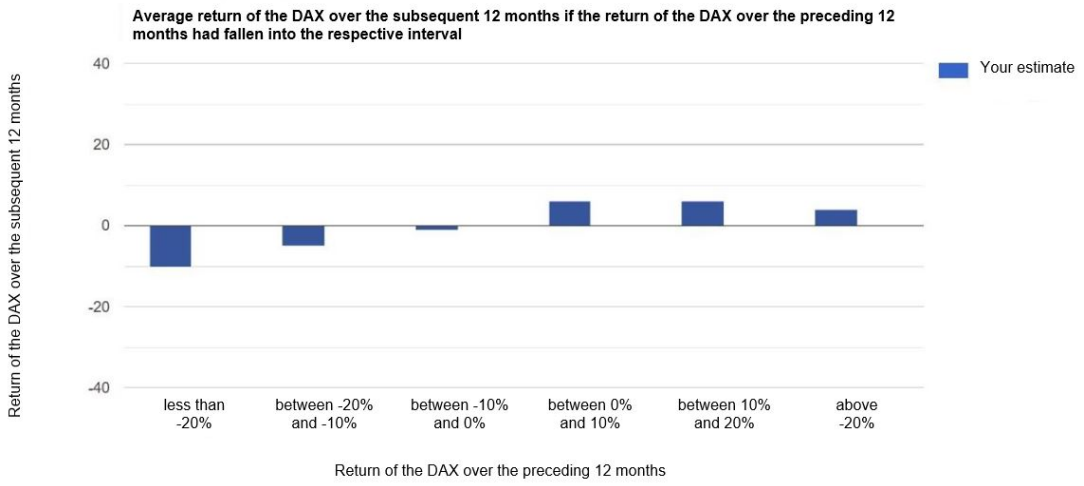
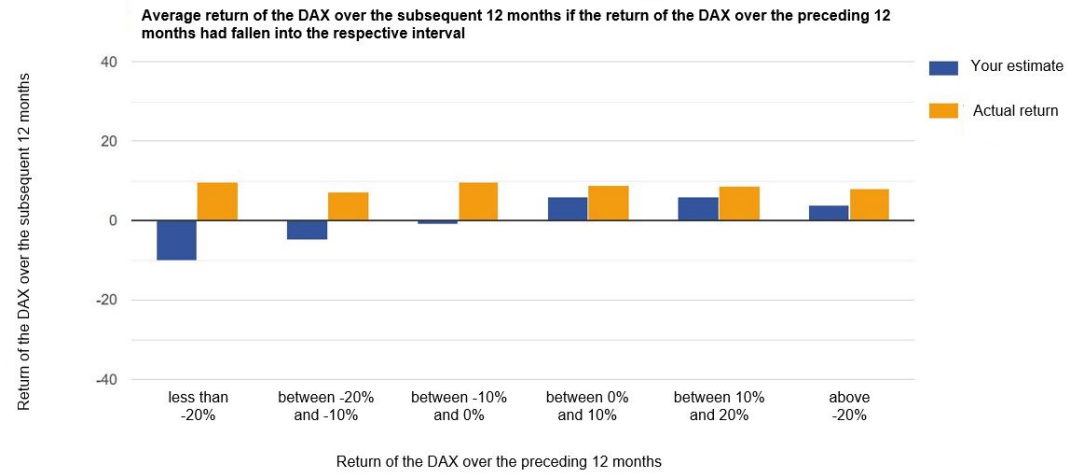
Main figures

Figure 1: Elicitation of prior perceived autocorrelation and information treatment



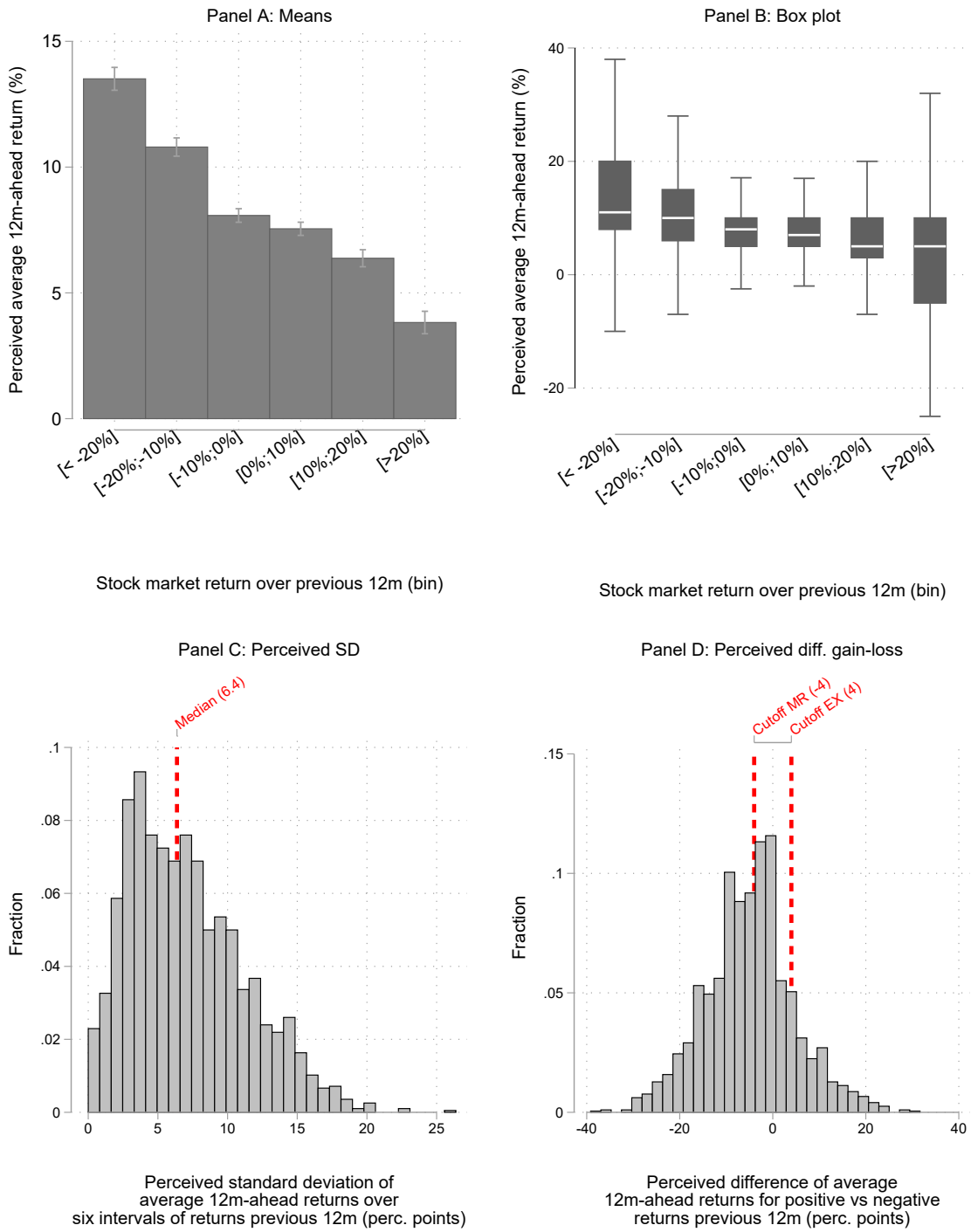
(a) Panel A: Priors



(b) Panel B: Information treatment

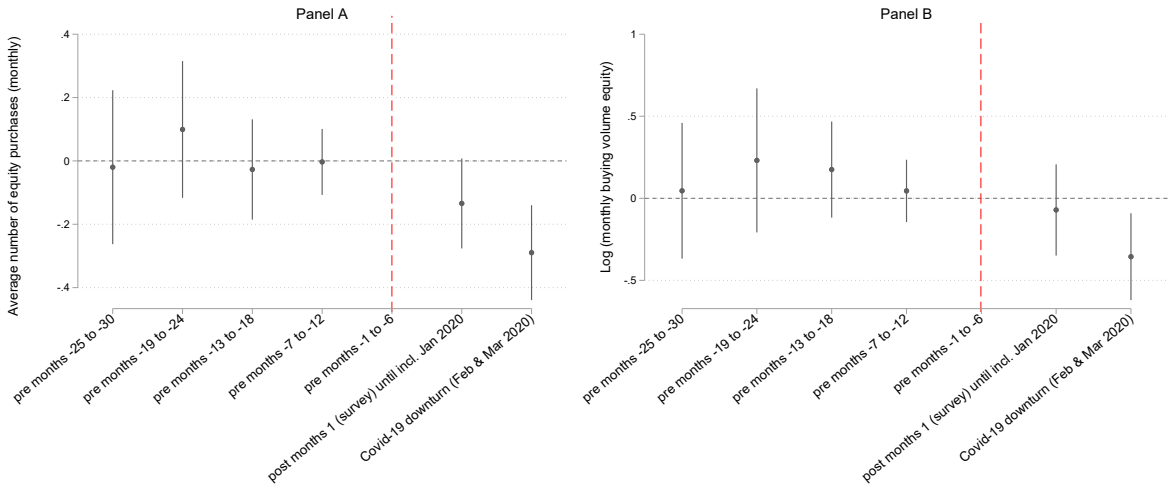
Notes: This figure presents example survey screens (translated from German to English) of the elicitation of priors and the information treatment. Panel A illustrates the elicitation of prior beliefs about the historical autocorrelation of aggregate stock returns. For each of the six intervals on the horizontal axis, starting with the lowest one on the left, respondents are instructed to think of all points in time over the past 50 years at which the return of the DAX over the preceding 12 months had fallen into the respective interval, and ask them to estimate the conditional average return of the DAX over the subsequent 12 months. Each interval is asked about on a separate screen. On each screen, the graph displays the respondent's entry for the current interval as well as his or her estimates for previous intervals (blue bars). Panel B displays the information treatment screen shown to respondents in the treatment group. The orange bars illustrate the actual historical conditional mean 12 months-ahead returns in the six past-return intervals, respectively. Initially, the screen only shows the participants' entries previously made in all six scenarios. Participants are instructed to repeatedly click on a button to receive information on the actual values interval-by-interval. In addition, for each bin, we display a sentence above the figure comparing the respondent's prior with the actual value for the respective bin.

Figure 2: Prior beliefs about the autocorrelation of aggregate returns



Notes: This figure summarizes our respondents' prior beliefs about the autocorrelation of returns of the German stock market in the last 50 years. Panel A shows the sample means of respondents' beliefs about average 12 months-ahead stock returns for six intervals of realized returns over the previous 12 months. Panel B displays box plots of respondents' prior beliefs about average 12 months-ahead stock returns for the six intervals of realized return over the previous 12 months, including median, 25th and 75th percentile for each interval. Panel C shows a histogram of respondents' perceived standard deviation of 12 months-ahead returns over the six realized return intervals. Panel D shows a histogram of respondents' perceived difference in average 12 months-ahead returns between the positive and the negative realized return scenarios, including the cutoffs we use to define mean reverters, neutrals and extrapolators.

Figure 3: Buying behavior during the COVID-19 downturn: Active investors with prior beliefs in mean reversion



Notes: This figure displays treatment effects on different measures of buying behavior during different periods implied by investor-month level estimations of specification 5. The period spanning the 6 months preceding the survey is omitted. The "post months" are the time from including the survey month (September-November 2020) until including January 2020, and the displayed coefficient is the estimate on the term "Post x Treatment" in specification 5. The "Covid-19"-period includes February and March 2020, and the displayed coefficient is the sum of the estimates on the terms "Post x Treatment" and "Covid-19 x Post x Treatment" in specification 5. The displayed coefficients on the different pre-periods are the estimates on the interaction terms of dummies for these periods with the treatment dummy. The outcomes are the monthly number of equity purchases (Panel A) and the log of the monthly equity buying volume, where the value one is added to the volume before taking logs (Panel B). The sample is restricted to those who believe in mean reversion before the treatment (for whom the perceived difference in average year-ahead returns between the positive and the negative realized return scenarios is less than -4 percentage points), and is restricted to active investors, i.e. those in the lowest quartile of number of trades over the 12 months before the survey are excluded. All specifications control for month-year as well as individual fixed effects, non-interacted dummies for event periods, and lagged log financial wealth held at the broker. 95-percent confidence bands are obtained using standard errors that are two-way clustered by investor and trading-month.

Main tables

Table 1: Summary statistics and balance check

	PHF	Online brokerage sample							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2017 Mean	Mean	Median	SD	p25	p75	Treatment Group: Mean	Control Group: Mean	p-value (7) = (8)
Female	0.49	0.16	0.00	0.37	0.00	0.00	0.17	0.16	0.511
Age	50.55	45.24	45.00	14.15	34.00	55.00	45.84	44.66	0.067
University	0.15	0.54	1.00	0.50	0.00	1.00	0.52	0.56	0.079
Employed	0.65	0.77	1.00	0.42	1.00	1.00	0.75	0.78	0.150
Household net income	3,808	3,914	4,000	2,769	2,000	5,250	3,927	3,902	0.837
Household net wealth	361,783	300,488	125,000	458,044	12,500	375,000	307,809	293,294	0.483
Total financial wealth at bank		55,272	22,082	98,312	5,581	65,752	55,073	55,468	0.929
Portfolio value at bank		43,970	14,872	87,671	3,726	47,620	43,438	44,489	0.795
Equity holdings at bank		39,313	13,381	78,466	3,437	42,458	38,165	40,435	0.530
Average monthly equity trades		1.73	0.67	3.29	0.00	2.00	1.75	1.71	0.812
Risk tolerance (1-7)		4.56	5.00	1.17	4.00	5.00	4.54	4.58	0.403
Trading experience (years)		14.13	15.00	10.87	4.00	20.00	14.38	13.89	0.309
Financial literacy score (0-3)		1.82	2.00	0.78	1.00	2.00	1.81	1.83	0.543
Follow DAX developments (1-7)		4.76	5.00	1.81	3.00	6.00	4.78	4.75	0.737
Investment horizon $\geq$ 5 years		0.49	0.00	0.50	0.00	1.00	0.48	0.50	0.373
Perceived return last 12 months		5.09	5.00	6.07	2.00	8.00	4.99	5.19	0.475
Confident in perceived return		0.64	1.00	0.48	0.00	1.00	0.64	0.64	0.855
Expected return next 12 months		3.21	4.00	6.28	1.50	6.00	3.32	3.09	0.423
Confident in expected return		0.54	1.00	0.50	0.00	1.00	0.54	0.53	0.494
Perceived mean hist. ret. intervals		8.36	7.83	4.62	5.17	11.17	8.39	8.32	0.739
Perceived SD hist. ret. intervals		7.05	6.37	4.16	3.78	9.82	7.10	7.01	0.629
High perceived SD		0.50	0.00	0.50	0.00	1.00	0.52	0.48	0.099
Perceived diff. gain-loss historical		-4.88	-4.67	9.64	-10.67	0.50	-4.68	-5.08	0.360
Extrapolator (diff. $\geq$ 4)		0.16	0.00	0.36	0.00	0.00	0.16	0.15	0.725
Mean-reverter (diff. $<$ -4)		0.53	1.00	0.50	0.00	1.00	0.53	0.52	0.789
In follow-up sample		0.46	0.00	0.50	0.00	1.00	0.46	0.46	0.886
Observations		1,961					972	989	

Notes: This table shows summary statistics for our sample of retail investors at the online bank (Columns 2-6), as well as benchmarks from the German population of individuals participating in the stock market as measured in the 2017 wave of the Bundesbank's Panel of Household Finance (Column 1). Columns 7-9 provide a check of balance of means between treatment and control group. Variables on income, wealth and wealth components are expressed in euro terms. Financial wealth at the bank, portfolio value at the bank, and equity holdings at the bank are measured in the month prior to the survey. Average monthly equity trades are measured over the three months preceding the survey. All belief variables reported in the table refer to respondents' priors elicited before the information treatment.

Table 2: Correlates of beliefs

	Perceived return last 12m	Expected return next 12m	Perceived mean hist. ret.	Perceived SD	Perceived SD ≥ Median	Perceived diff. gain-loss	Extra-polator (diff. ≥ 4)	Neutral (-4 ≤ diff. < 4)	Mean-reverter (diff. < -4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	-0.476	0.456	0.108	-0.445*	-0.000	2.534***	0.097***	-0.013	-0.084***
	(0.381)	(0.347)	(0.299)	(0.238)	(0.031)	(0.590)	(0.025)	(0.029)	(0.030)
Age	0.011	0.017	0.023**	-0.038***	-0.004***	-0.006	-0.002**	0.004***	-0.002**
	(0.013)	(0.013)	(0.009)	(0.008)	(0.001)	(0.019)	(0.001)	(0.001)	(0.001)
Employed	0.560	0.068	-0.179	-0.289	-0.027	-0.542	-0.043**	0.041	0.002
	(0.348)	(0.337)	(0.260)	(0.227)	(0.028)	(0.534)	(0.021)	(0.025)	(0.027)
University	-0.762***	-0.564*	-0.358*	0.629***	0.066***	-1.556***	-0.016	-0.036*	0.053**
	(0.287)	(0.291)	(0.209)	(0.192)	(0.023)	(0.440)	(0.017)	(0.022)	(0.023)
Log(Household income)	0.013	0.040	0.010	0.009	0.002	-0.120	-0.002	-0.006	0.008**
	(0.051)	(0.053)	(0.038)	(0.033)	(0.004)	(0.077)	(0.003)	(0.004)	(0.004)
Log(Fin. wealth with bank)	-0.049	0.000	-0.051	-0.034	-0.006	-0.208	-0.008	-0.011	0.018***
	(0.084)	(0.083)	(0.064)	(0.056)	(0.007)	(0.129)	(0.005)	(0.007)	(0.007)
Invest. experience ≥ Median	-0.158	-1.658***	0.035	0.467**	0.069**	-1.299**	-0.038*	-0.056**	0.094***
	(0.364)	(0.376)	(0.252)	(0.232)	(0.028)	(0.524)	(0.021)	(0.027)	(0.028)
Full financial literacy score	-0.521	-1.100***	0.102	0.203	0.067**	-0.654	-0.022	-0.052**	0.074***
	(0.350)	(0.389)	(0.247)	(0.224)	(0.028)	(0.513)	(0.019)	(0.025)	(0.028)
Follow DAX ≥ Median	-0.162	0.805**	0.320	0.405**	0.050**	-0.942**	-0.004	-0.067***	0.070***
	(0.305)	(0.316)	(0.219)	(0.203)	(0.024)	(0.469)	(0.017)	(0.022)	(0.024)
Mean dep. var.	5.09	3.20	8.31	7.05	0.50	-4.88	0.16	0.32	0.52
SD dep. var.	6.07	6.28	4.48	4.16	0.50	9.64	0.36	0.47	0.50
Observations	1,961	1,961	1,961	1,961	1,961	1,961	1,961	1,961	1,961
R-squared	0.01	0.02	0.01	0.02	0.02	0.04	0.03	0.02	0.04

Notes: This table shows multivariate regressions of respondents' beliefs on covariates. The outcomes are the respondent's perceived return of the DAX over the 12 months before the survey (Column 1), the expected return over the 12 months after the survey (Column 2), the perceived mean of year-ahead returns over the six historical realized return intervals (Column 3), the perceived standard deviation over these intervals (Column 4), a dummy indicating whether this standard deviation is at least at the sample median (Column 5), the perceived difference in average year-ahead returns between the positive and the negative realized return scenarios (Column 6), a dummy for extrapolators (for which this difference is at least 4 percentage points, Column 7), a dummy for being neutral (difference at least -4 and less than 4, Column 8), and a dummy for mean reverters (difference less than -4, Column 9). Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 3: Perceived autocorrelation and trading decisions

	Purchases			Sales			Net purchases
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Prob (buy)	# of purchases	Log buying volume	Prob (sell)	# of sales	Log selling volume	Net log buying
Panel A: Full Sample							
DAX down ×	-0.027**	-0.104**	-0.185**	-0.007	-0.008	-0.058	-0.127
Extrapolator (diff. ≥ 4)	(0.012)	(0.042)	(0.085)	(0.008)	(0.013)	(0.061)	(0.096)
DAX down ×	-0.012	-0.049*	-0.120**	-0.002	0.001	0.003	-0.123**
Neutral (-4 ≤ diff. < 4)	(0.009)	(0.028)	(0.058)	(0.006)	(0.009)	(0.044)	(0.060)
Observations	76,008	76,008	76,008	76,008	76,008	76,008	76,008
R-squared	.49	.618	.361	.114	.121	.123	.249
Panel B: Excl. short oberservation periods							
DAX down ×	-0.031**	-0.106**	-0.214**	-0.011	-0.011	-0.079	-0.135
Extrapolator (diff. ≥ 4)	(0.014)	(0.042)	(0.092)	(0.008)	(0.013)	(0.066)	(0.104)
DAX down ×	-0.014	-0.047*	-0.128**	-0.001	0.005	0.019	-0.147**
Unbiased (-4 ≤ diff. < 4)	(0.009)	(0.027)	(0.060)	(0.006)	(0.010)	(0.047)	(0.062)
Observations	67,108	67,108	67,108	67,108	67,108	67,108	67,108
R-squared	.481	.596	.352	.111	.116	.121	.237
Panel C: Active Investors							
DAX down ×	-0.045**	-0.165***	-0.306**	-0.016	-0.019	-0.127	-0.178
Extrapolator (diff. ≥ 4)	(0.017)	(0.060)	(0.115)	(0.010)	(0.017)	(0.084)	(0.129)
DAX down ×	-0.019*	-0.064*	-0.179**	-0.007	-0.004	-0.025	-0.154**
Neutral (-4 ≤ diff. < 4)	(0.011)	(0.037)	(0.075)	(0.008)	(0.013)	(0.059)	(0.074)
Observations	53,746	53,746	53,746	53,746	53,746	53,746	53,746
R-squared	.461	.612	.317	.112	.119	.124	.24
Panel D: Active Investors							
DAX down ×	0.027***	0.094***	0.217***	0.009	0.008	0.056	0.161**
Mean Reverters (diff. < -4)	(0.010)	(0.034)	(0.067)	(0.007)	(0.012)	(0.054)	(0.069)
Observations	53,746	53,746	53,746	53,746	53,746	53,746	53,746
R-squared	.461	.612	.317	.112	.119	.124	.24
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table examines the association between beliefs about the autocorrelation of aggregate returns and trading activity at the online bank based on investor-month level estimations of specification 1. Columns 1-3 focus on the buying side, Columns 4-6 on the selling side, and Column 7 on net buying. Specifically, prob(buy) (prob (sale)) is an indicator for whether the respondent conducts one or more equity purchases (sales) during a given month, number of purchases (number of sales) is the number of buying (selling) transactions in equities in a given month, and log buying (selling) volume is the log of the overall transaction value of all equity purchases (sales) in a given month, where the value one is added to the volume before taking logs. Extrapolators are those investors for whom the prior perceived difference in average year-ahead returns between the positive and the negative realized return scenarios is at least 4 percentage points, those with a difference of at least -4 and less than 4 percentage points are classified as neutral, and those with a difference lower than -4 are classified as mean reverters. DAX down is a dummy indicating whether the return of the DAX over the preceding 12 months was negative. For the return calculation, we use the average return compared to 12 months earlier across all trading days in the current month. The transaction data span the period from December 2014 until the month before the survey month (between September and November 2019) for the treatment group and until including January 2020 for the control group. Panel A reports results for the full sample, Panel B focuses on investors that we observe for more than half of our sample period, and Panels C and D focus on a subsample of active investors, where the lowest quartile in terms of the number of trades over the previous 12 months is excluded. All estimations include individual and month-year fixed effects and control for lagged log financial wealth held with the bank. Standard errors are two-way clustered by investor and trading month and are presented in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 4: Beliefs about the stock market and the equity share

	Equity Share				
	(1)	(2)	(3)	(4)	(5)
Panel A: Full Sample					
DAX down × Extrapolator (diff. ≥ 4)	-2.432***				
	(0.907)				
DAX down × Neutral (-4 ≤ diff. < 4)	-0.181				
	(0.586)				
DAX down × Mean Reverter (diff. < -4)		0.882			
		(0.530)			
Perceived conditional historical return			0.146**	0.149**	0.034
			(0.066)	(0.060)	(0.024)
Perceived mean historical return				-0.008	
				(0.157)	
Observations	76,008	76,008	76,032	76,032	76,008
R-squared	.756	.756	.06	.06	.756
Panel B: Excl. short oberservation periods					
DAX down × Extrapolator (diff. ≥ 4)	-2.496**				
	(0.959)				
DAX down × Neutral (-4 ≤ diff. < 4)	-0.506				
	(0.612)				
DAX down × Mean Reverter (diff. < -4)		1.120**			
		(0.548)			
Perceived conditional historical return			0.171**	0.180***	0.052**
			(0.071)	(0.065)	(0.025)
Perceived mean historical return				-0.027	
				(0.175)	
Observations	67,108	67,108	67,108	67,108	67,108
R-squared	.757	.757	.065	.065	.757
Panel C: Active Investors					
DAX down × Extrapolator (diff. ≥ 4)	-2.403**				
	(0.972)				
DAX down × Neutral (-4 ≤ diff. < 4)	-0.145				
	(0.650)				
DAX down × Mean Reverter (diff. < -4)		0.821			
		(0.593)			
Perceived conditional historical return			0.126*	0.138**	0.017
			(0.063)	(0.057)	(0.026)
Perceived mean historical return				-0.035	
				(0.154)	
Observations	53,746	53,746	53,918	53,918	53,746
R-squared	.737	.737	.075	.075	.737
Time FE	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	No	No	Yes

Notes: This table examines the association between beliefs and the equity share held with the bank based on investor-month level estimations. Extrapolators are those investors for whom the prior perceived difference in average year-ahead returns between the positive and the negative realized return scenarios is at least 4 percentage points, those with a difference of at least -4 and less than 4 percentage points are classified as neutral, and those with a difference lower than -4 are classified as mean reverters. DAX down is a dummy indicating whether the return of the DAX over the preceding 12 months was negative. For the return calculation, we use the average return compared to 12 months earlier across all trading days in the current month. The perceived conditional historical return is the return an investor would expect if he or she based her return expectations exclusively on her beliefs about the historical autocorrelation of returns (taken from the survey) assuming accurate beliefs about the realized return over the previous 12 months. The perceived mean historical return is the average of respondents' historical year-ahead return perceptions over the six intervals of previously realized returns. The transaction data span the period from December 2014 until the month before the survey month (between September and November 2019) for the treatment group and until including January 2020 for the control group. Panel A reports results for the full sample, Panel B focuses on investors that we observe for more than half of our sample period, and Panel C focuses on a subsample of active investors, where the lowest quartile in terms of the number of trades over the previous 12 months is excluded. All specifications control for month-year fixed effects and lagged log financial wealth with the bank. The pooled OLS estimations in Columns 3 and 4 also include the baseline set of controls measured at the time of the survey described in Appendix A, excluding the variables relating to portfolio shares and trading activity. Standard errors are two-way clustered by investor and trading month and are presented in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 5: Manipulation check

	Positive return irrespective of previous return		No sense to buy after high return		Positive return more likely after high return		Above average return after negative return		Negative return likely to continue next year	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treatment	0.093**		-0.054		-0.147***		-0.326***		-0.452***	
	(0.044)		(0.044)		(0.045)		(0.067)		(0.065)	
Treatment × Perceived SD ≥ Median (a)		0.166***								
		(0.062)								
Treatment × Perceived SD < Median (b)		0.020								
		(0.062)								
Perceived SD ≥ Median	-0.049	-0.121*								
	(0.044)	(0.063)								
Treatment × Extrapolator (diff. ≥ 4) (a)				0.021		-0.375***		-0.382**		-0.916***
				(0.114)		(0.115)		(0.176)		(0.189)
Treatment × Neutral (-4 ≤ diff. < 4)				0.075		-0.084		0.088		-0.274**
				(0.080)		(0.081)		(0.123)		(0.115)
Treatment × Mean-reverter (diff. < -4) (b)				-0.155***		-0.114*		-0.556***		-0.428***
				(0.060)		(0.062)		(0.087)		(0.086)
Extrapolator (diff. ≥ 4)			-0.018	0.008	0.143**	0.288***	-0.053	0.172	0.165	0.469***
			(0.071)	(0.098)	(0.072)	(0.102)	(0.109)	(0.131)	(0.115)	(0.159)
Mean-reverter (diff. < -4)			0.046	0.160**	-0.127**	-0.113	0.031	0.340***	-0.076	-0.007
			(0.051)	(0.070)	(0.053)	(0.072)	(0.076)	(0.098)	(0.073)	(0.100)
p-value (a=b)		0.098		0.174		0.047		0.379		0.019
Observations	1,961	1,961	1,961	1,961	1,961	1,961	903	903	903	903
R-squared	0.10	0.10	0.08	0.08	0.04	0.04	0.11	0.13	0.12	0.13

Notes: This table shows estimations of the effect of the information treatment on respondents' posterior agreement to verbal statements describing beliefs about the autocorrelation of aggregate returns. Agreement to the statements is elicited on 7-point categorical scales, and is z-scored using the means and standard deviations in the sample. The statements are: "With an investment in stocks one can expect a positive return, independently of how the stock market has developed in the recent past." (Columns 1-2); "When the stock market has recently increased it makes no sense to buy stocks." (Columns 3-4); "When the stock market has recently increased it is more likely that stock returns will be positive over the following time than when the stock market has recently decreased." (Columns 5-6); "When the stock market has fallen in the previous year one can expect above-average returns for the next year." (Columns 7-8); "When the stock market has fallen over the previous 12 months there is a high probability that this trend will continue in the following 12 months." (Columns 9-10). The outcomes in Columns 1-6 are elicited in the main survey and the outcomes in Columns 7-10 are elicited in the follow-up survey after the repeated information treatment. Column 2 shows heterogeneous treatment effects by holding an above or below median prior perceived standard deviation of year-ahead returns over the six historical realized return intervals. Columns 4, 6, 8 and 10 show heterogeneous treatment effects for prior extrapolators (perceived difference in average year-ahead returns between the positive and the negative realized return scenarios at least 4 percentage points), neutrals (difference at least -4 and less than 4), and mean reverters (difference less than -4). All estimations include the baseline set of controls described in Appendix A. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 6: Updating of 12 month-ahead return expectations

	Updating (point belief) main survey		Updating (mean distr.) main survey		Updating (point belief) main survey follow-up sample		Updating (point belief) follow-up survey	
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
Treatment × Perception gap main	0.086**	0.138***	0.115***	0.142**	0.118**	0.134*		
	(0.038)	(0.051)	(0.044)	(0.060)	(0.056)	(0.076)		
Perception gap main	-0.004	-0.019	0.022	0.044	-0.054	-0.020		
	(0.025)	(0.033)	(0.028)	(0.038)	(0.035)	(0.048)		
Treatment × Perception gap follow-up							0.136*	0.276**
							(0.080)	(0.122)
Perception gap follow-up							-0.069	-0.129
							(0.056)	(0.080)
Treatment	1.077***	1.007***	0.047	0.019	1.130***	1.109***	0.482	0.236
	(0.212)	(0.219)	(0.263)	(0.266)	(0.312)	(0.316)	(0.426)	(0.436)
First stage F-stat		1020.48		1020.48		534.73		355.35
Observations	1,961	1,961	1,961	1,961	903	903	903	903
R-squared	0.05	0.04	0.04	0.04	0.07	0.07	0.05	0.04

Notes: This table examines changes in expectations about aggregate stock returns over the 12 months after the survey in response to the information. The outcomes are the difference between posterior and prior point expectations about the 12 month-ahead return, both measured in the main survey (Columns 1, 2, 5 and 6); the difference between the mean of the respondent-level posterior distribution over 12-month ahead returns and the prior point expectation, both measured in the main survey (Columns 3-4); and the difference between the posterior point expectation measured at the start of the follow-up survey (*before* the repeated information treatment) and the prior point expectation measured in the main survey (Columns 7-8). The perception gap is based on the respondent's prior belief about the historical autocorrelation of aggregate returns. It is the difference between the actual conditional mean 12 month-ahead return and the respondent's corresponding prior for the relevant scenario of realized returns over the previous 12 months, which is selected based on respondent's perceived return over the 12 months before the main survey (Columns 1-6) or before the follow-up survey (Columns 7-8). In Columns 2, 4, 6 and 8 the perception gap is instrumented with a version in which the relevant return interval is selected based on the actual realized return of the DAX over the 12 months before the survey. Columns 1-4 are based on the full sample, while Columns 5-8 are based on respondents who are part of the follow-up sample. All estimations include the baseline set of controls described in Appendix A. Columns 5-8 also control for dummies for the time between main and follow-up survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 7: Trading behavior during the COVID-19 downturn: Active investors

	Purchases			Sales			Net purchases
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Prob (buy)	# of purchases	Log buying volume	Prob (sell)	# of sales	Log selling volume	Net log buying
Panel A: Sample of non-treated investors							
Covid-19 × Post × Mean Reverter	0.030	0.203**	0.315	0.031*	0.079***	0.188	0.127
	(0.019)	(0.088)	(0.195)	(0.017)	(0.025)	(0.178)	(0.146)
Post × Mean Reverter	-0.039*	-0.065	-0.193	0.015	0.025	0.155	-0.348**
	(0.020)	(0.083)	(0.169)	(0.019)	(0.031)	(0.154)	(0.164)
Observations	29,728	29,728	29,728	29,728	29,728	29,728	29,728
R-squared	.445	.585	.293	.098	.097	.113	.238
Panel B: Treatment effects - Mean Reverter							
Covid-19 × Post × Treatment	-0.020**	-0.155***	-0.285**	-0.029*	-0.075**	-0.192	-0.093
	(0.009)	(0.049)	(0.127)	(0.017)	(0.033)	(0.137)	(0.188)
Post × Treatment	-0.007	-0.134*	-0.071	0.013	0.022	0.090	-0.161
	(0.016)	(0.071)	(0.139)	(0.017)	(0.031)	(0.122)	(0.131)
Observations	32,859	32,859	32,859	32,859	32,859	32,859	32,859
R-squared	.462	.623	.326	.104	.107	.117	.242
Panel C: Treatment effects - Non Mean Reverter							
Covid-19 × Post × Treatment	0.016	0.035	0.189	0.005	0.030	0.057	0.132
	(0.021)	(0.059)	(0.157)	(0.017)	(0.034)	(0.151)	(0.179)
Post × Treatment	-0.025	-0.131*	-0.128	0.017	0.008	0.127	-0.255
	(0.020)	(0.071)	(0.168)	(0.016)	(0.028)	(0.115)	(0.201)
Observations	25,155	25,155	25,155	25,155	25,155	25,155	25,155
R-squared	.451	.575	.307	.123	.133	.134	.235
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table examines the association between beliefs about the autocorrelation of aggregate returns and trading activity during the COVID-19 crash (Panel A) and the effect our information treatment on trading activity during the crash among different groups (Panels B and C) based on investor-month level estimations of specifications 4 and 5. The samples are restricted to active investors, i.e. those in the lowest quartile of number of trades over the 12 months before the survey are excluded. Columns 1-3 focus on the buying side, Columns 4-6 on the selling side, and Column 7 on net buying. Specifically, prob(buy) (prob (sale)) is an indicator for whether the respondent conducts one or more equity purchases (sales) during a given month, number of purchases (number of sales) is the number of buying (selling) transactions in equities in a given month, and log buying (selling) volume is the log of the overall transaction value of all equity purchases (sales) in a given month, where the value one is added to the volume before taking logs. The transaction data span the period from December 2014 until March 2020. Panel A focuses on respondents in the control group. Panel B includes respondents believing in mean reversion before the intervention from both the treatment and the control group (for whom the prior perceived difference in average year-ahead returns between the positive and the negative realized return scenarios is less than -4 percentage points), while Panel C focuses on non-mean reverters (difference -4 percentage points or higher). All specifications control for month-year as well as individual fixed effects and lagged log financial wealth held with the bank. Standard errors are two-way clustered by investor and trading month and are presented in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

For Online Publication: Appendix: Beliefs About the Stock Market and Investment Choices: Evidence from a Field Experiment

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A Details on control variables

To account for small imbalances across treatment arms (see Table 1) and to increase power, we include a set of control variables in our estimations. Our baseline set of control variables is the following: demographics: a dummy for being female, a linear measure of age, dummies for being employed and for holding a university degree, the logs of the respondent's household's net income and net wealth[4]; survey measures of investor behavior: dummies for different levels of trading experience, financial literacy, attention to the DAX, investment horizon, sources of financial information and risk tolerance; administrative measures of holdings with the bank at the time of the survey: the log of total financial wealth held with the bank, the equity share and dummies for holding an equity share of 0 or 100 percent, the share of other securities, dummies for number of equity trades over the previous three months and length of relationship with the bank; technical controls: dummies for passing an attention screener, self-reported survey difficulty, use of external information in the response, experiencing a technical issue and taking the survey on a mobile phone. None of our results are sensitive to the exact set and construction of control variables included.

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[4]We elicit net wealth and income using survey questions with categorical response options, and construct continuous variables based on the mid-points of the corresponding bins. The lowest response categories are "no net wealth" or "no income", for which we assign the value zero. We construct the logs of the variables after adding the value one.

B Comparison of elasticity of portfolios to beliefs with Giglio, Maggiori, Stroebel and Utkus (2021a)

In a sample of wealthy Vanguard clients in the US, Giglio, Maggiori, Stroebel and Utkus (2021a) estimate a relationship between an investor's equity share and her return expectations of between 0.7 and 1.2 depending on the specification – an order of magnitude below theory benchmarks for plausible preference parameters. In Table 4 we regress an investor's equity share in a given month within the period of roughly five years preceding our survey on the investor's subjective return expectation for the next 12 months, which we predict based on i) the actual realized return over the preceding 12 months, and ii) a respondent's belief about the historical conditional average 12-month-ahead return if realized returns fell into the interval corresponding to i). Our estimates based on pooled OLS regressions, which are most directly comparable to the results in Giglio, Maggiori, Stroebel and Utkus (2021a), range between 0.126 and 0.180 depending on the exact specification and sample used, smaller than estimated by Giglio, Maggiori, Stroebel and Utkus (2021a).

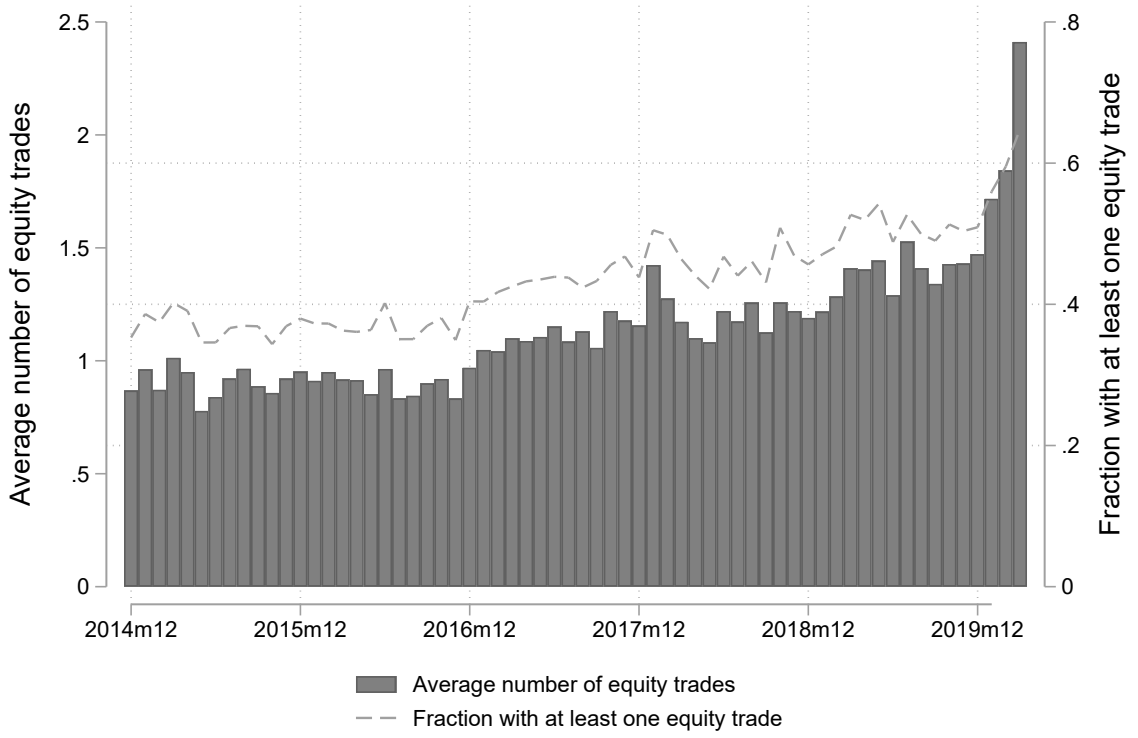
One reason for our smaller estimates could be that we predict investors' expectations depending on their beliefs about the historical autocorrelation of aggregate returns and on realized returns over the previous 12 months. Investors' actual return expectations may deviate because i) other factors than their beliefs about historical returns could influence investors' return expectations at any point in time (as e.g. suggested by the less than one-to-one relationship documented in Panel A of Figure A.4), and ii) as actually realized DAX returns are an imperfect proxy for investors' perceived returns over the previous 12 months (see Figure A.3).

To make the effect sizes comparable to the results in Giglio, Maggiori, Stroebel and Utkus (2021a), we first regress investors' 12-month-ahead return expectations at the time of our survey on a measure of investors' predicted 12-month-ahead return expectations based on the respondents' perceived historical autocorrelation of returns and the actual returns realized over the 12 months before the respondent took the survey. As shown in Panel B of Figure A.4, conditional on our baseline set of controls, we obtain an estimated relationship of 0.169, which is highly statistically significant. We adjust our estimates of the elasticity of the equity share to beliefs ranging from 0.126 to 0.180 for the fact that

we predict the respondent's expectations by dividing it by 0.169. The resulting adjusted elasticities range between 0.746 and 1.065 – remarkably close to the estimates in Giglio, Maggiori, Stroebel and Utkus (2021a).

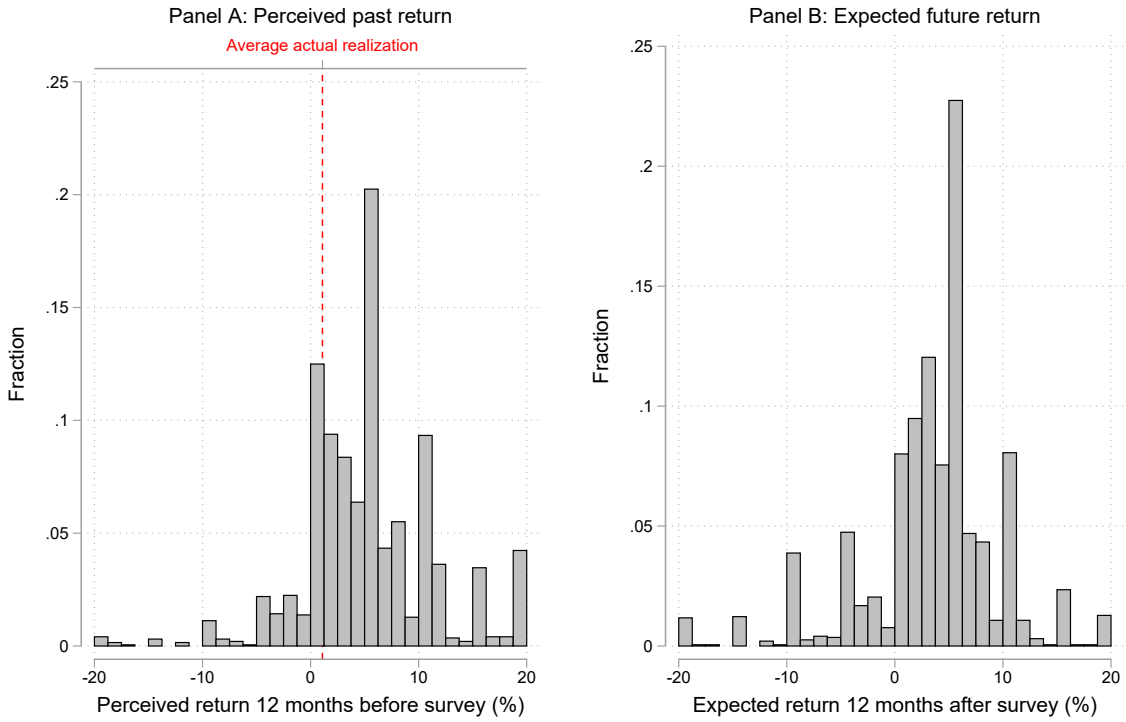
C Additional figures

Figure A.1: Trading activity over the sample period



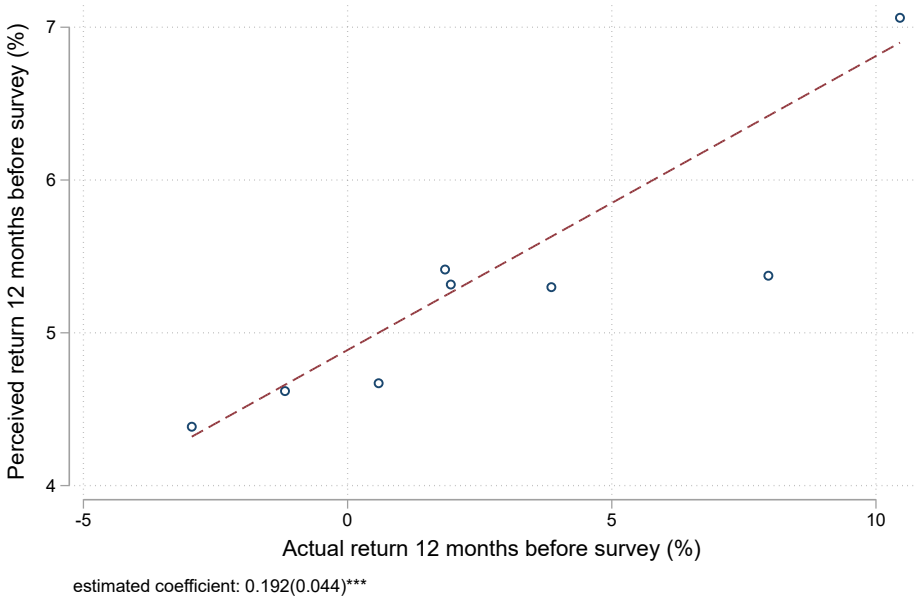
Notes: This figure displays the mean number of equity trades (left axis) and the fraction of investors conducting at least one equity trade (right axis) by month over the sample period. Trades include both purchases and sales of equity.

Figure A.2: Prior beliefs about return 12 months before and after the survey



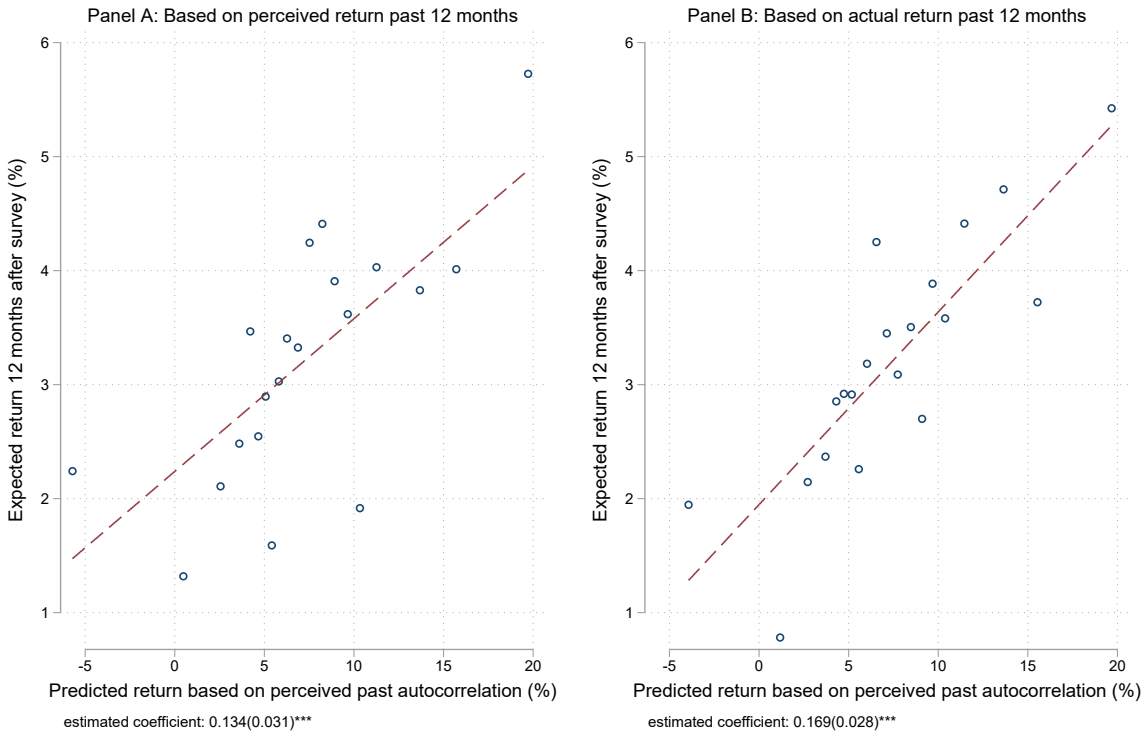
Notes: This figure displays histograms of respondents' prior beliefs about the return of the German stock market over the 12 months before and the 12 months after the survey. Our sample focuses on respondents with a prior expected return over the next 12 months between -20 and 20 percent. The perceived return over the last 12 months is winsorized at -20 and 20 percent.

Figure A.3: Binned scatter plot of perceived vs actual return realization



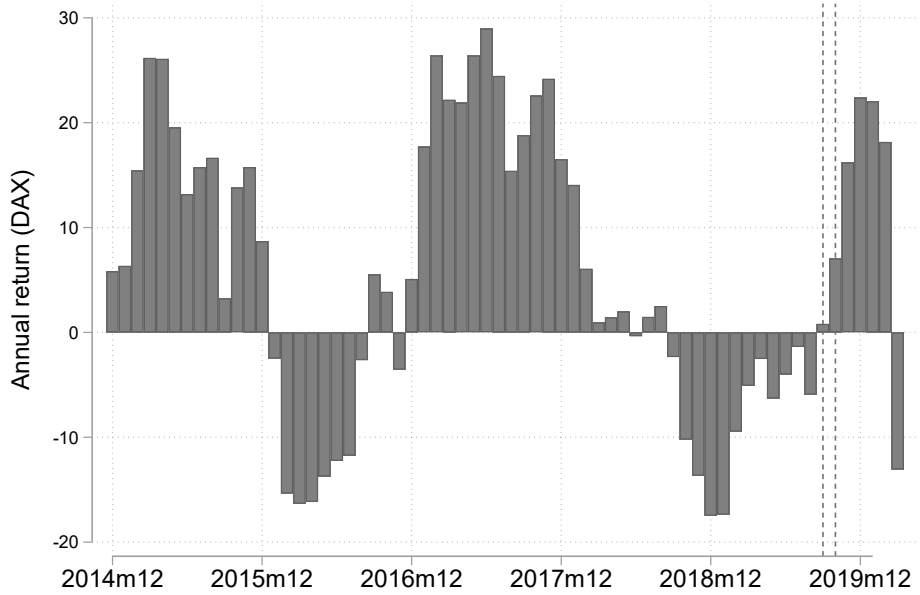
Notes: This figure shows a binned scatter plot of respondents' perceived return over the 12 months before the survey against the actual return realization over the 12 months until the day before the respondent took the survey. Actual returns vary since the period in which respondents took the survey was spread over the time September-November 2019.

Figure A.4: Binned scatter plot of prior expected 12 month-ahead return vs predicted return expectation based on perceived historical autocorrelation



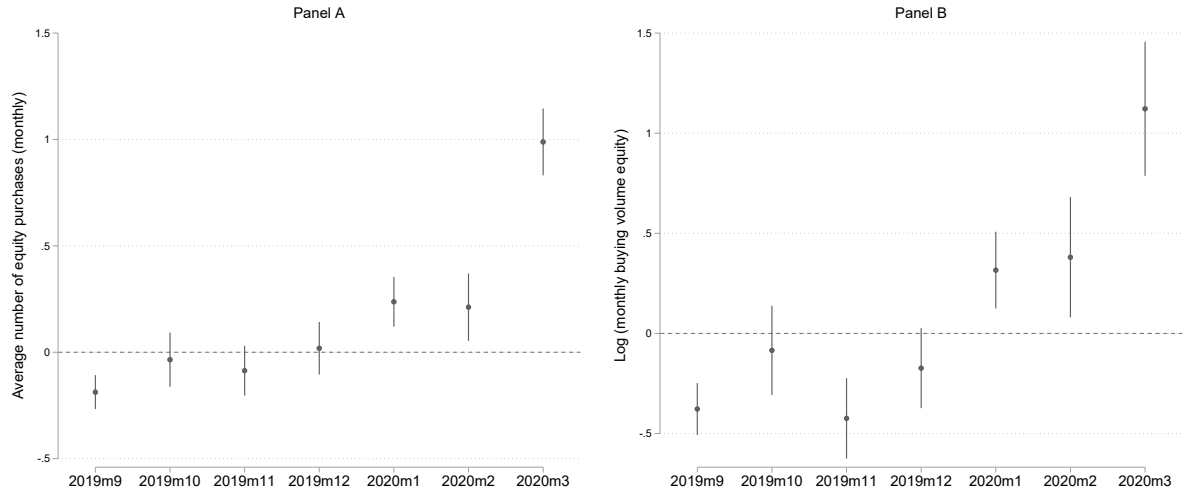
Notes: This figure shows binned scatter plots of respondents' prior expected return over the 12 months after the survey against the respondents' perceived average historical 12 month-ahead return in the relevant interval of realized returns, which is selected based on the respondent's perceived return over the 12 months before the survey (Panel A) or based on the actual realized return over the 12 months before the respondent took the survey (Panel B). The binned scatter plots partial out the baseline set of controls described in Appendix A.

Figure A.5: Annual returns of the German Stock index (DAX) over the sample period



Notes: This figure shows the return of the DAX over the previous 12 months for each month in the sample period. The dashed lines mark the time span in which investors responded to the survey.

Figure A.6: Buying behavior of non-treated non-mean reverters over time



Notes: This figure shows coefficient estimates on the month-year fixed effects based on investor-month level estimations of specification 4, where August 2020 is omitted. The effects capture the development of buying activity among non-treated non-mean reverters (for whom the perceived difference in average year-ahead returns between the positive and the negative realized return scenarios is at least -4 percentage points) over time. The outcomes are the monthly number of equity purchases (Panel A) and the log of the monthly equity buying volume, where the value one is added to the volume before taking logs (Panel B).

D Additional tables

Table A.1: Selection into the survey: Comparison with random sample

	(1) Survey Sample: Mean	(2) Survey Sample: SD	(3) Random Sample: Mean	(4) Random Sample: SD	(5) p-value (1) = (3)
Female	0.16	0.37	0.22	0.41	0.000
Age	45.24	14.15	52.02	15.25	0.000
Employed	0.77	0.42	0.61	0.49	0.000
Risk attitude (1-5)	4.25	1.18	4.37	1.18	0.000
Total financial wealth at bank	55,272	98,312	82,216	142,817	0.000
Portfolio value at bank	43,970	87,671	63,144	117,574	0.000
Equity Share	0.73	0.45	0.70	0.30	0.415
Average monthly trades	1.88	3.50	3.55	10.88	0.000
Average monthly equity trades	1.73	3.29	2.65	7.27	0.000
Observations	1,961	3,701	1,961	3,701	

Notes: This table shows summary statistics for our survey sample (Columns 1-2) and a sample randomly drawn from the bank's client pool (Columns 3-4). Column 5 provides the p-values for a test for differences in means between the survey and the random sample. Variables on wealth and portfolio holdings are expressed in euro terms. Financial wealth at the bank, portfolio value at the bank, and equity holdings at the bank are measured in the month prior to the survey. For the random sample, we measure financial wealth at the bank, portfolio value at the bank, and equity holdings at the bank in August 2020. Average monthly equity trades are measured over the three months preceding the survey. For the random sample we use the average monthly equity trades in June, July and August 2020.

Table A.2: Summary statistics by type

	Means						
	(1) Perceived SD< Median	(2) Perceived SD≥ Median	(3) p-value (1) = (2)	(4) Extra-polator (diff. ≥ 4)	(5) Neutral (-4 ≤ diff. < 4)	(6) Mean-reverter (diff. < -4)	(7) p-value (4) = (6)
Female	0.17	0.16	0.399	0.26	0.17	0.13	0.000
Age	46.20	44.29	0.003	41.80	46.21	45.69	0.000
University	0.51	0.58	0.001	0.48	0.50	0.58	0.002
Employed	0.77	0.77	0.882	0.73	0.77	0.78	0.131
Household net income	3,938	3,891	0.706	3,634	3,803	4,066	0.016
Household net wealth	303,524	297,449	0.769	238,624	277,908	332,660	0.002
Total financial wealth at bank	55,303	55,241	0.989	42,033	53,446	60,331	0.002
Portfolio value at bank	43,990	43,949	0.992	31,409	43,085	48,183	0.002
Equity holdings at bank	39,333	39,293	0.991	29,637	38,121	42,865	0.007
Average monthly equity trades	1.81	1.64	0.240	1.41	1.76	1.80	0.058
Risk tolerance (1-7)	4.53	4.59	0.303	4.38	4.54	4.63	0.001
Trading experience (years)	14.07	14.20	0.800	10.88	13.88	15.26	0.000
Financial literacy score (0-3)	1.74	1.89	0.000	1.66	1.73	1.91	0.000
Follow DAX developments (1-7)	4.67	4.86	0.020	4.40	4.58	4.98	0.000
Investment horizon ≥ 5 years	0.49	0.48	0.542	0.48	0.47	0.50	0.572
Perceived return last 12 months	5.13	5.05	0.788	4.86	5.42	4.96	0.789
Confident in perceived return	0.65	0.63	0.500	0.61	0.65	0.64	0.261
Expected return next 12 months	3.43	2.98	0.115	3.34	3.80	2.81	0.218
Confident in expected return	0.54	0.53	0.805	0.51	0.57	0.52	0.770
Perceived mean hist. ret. intervals	7.85	8.86	0.000	8.42	8.10	8.49	0.833
Perceived SD hist. ret. intervals	3.70	10.41	0.000	8.40	3.52	8.80	0.101
Perceived diff. gain-loss historical	-1.78	-7.98	0.000	10.22	-0.65	-11.95	0.000
In follow-up sample	0.46	0.46	0.767	0.41	0.46	0.47	0.046
Observations	981	980		307	625	1,029	

Notes: This table shows summary statistics for different types of investors classified according to their perceived historical autocorrelation of aggregate returns. Columns 1-2 split the sample at the median of the perceived standard deviation of year-ahead returns over the six historical realized return intervals. Columns 4-6 split the sample according to the perceived difference in average year-ahead returns between the positive and the negative realized return scenarios. Those with a perceived difference of at least 4 percentage points are classified as extrapolators, those with a perceived difference of at least -4 but less than 4 percentage points are classified as neutrals, and those with a perceived difference lower than -4 percentage points are classified as mean reverters. Variables on income, wealth and wealth components are expressed in euro terms. Financial wealth at the bank, portfolio value at the bank, and equity holdings at the bank are measured in the month prior to the survey. Average monthly equity trades are measured over the three months preceding the survey. All belief variables reported in the table refer to respondents' priors elicited before the information treatment.

Table A.3: Perceived autocorrelation and trading decisions: Alternative type definitions

	Purchases			Sales			Net purchases
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Prob (buy)	# of purchases	Log buying volume	Prob (sell)	# of sales	Log selling volume	Net log buying
Panel A: Active Investors - Baseline							
DAX down ×	-0.045**	-0.165***	-0.306**	-0.016	-0.019	-0.127	-0.178
Extrapolator (diff. $\geq$ 4)	(0.017)	(0.060)	(0.115)	(0.010)	(0.017)	(0.084)	(0.129)
DAX down ×	-0.019*	-0.064*	-0.179**	-0.007	-0.004	-0.025	-0.154**
Unbiased (-4 $\leq$ diff. $<$ 4)	(0.011)	(0.037)	(0.075)	(0.008)	(0.013)	(0.059)	(0.074)
Observations	53,746	53,746	53,746	53,746	53,746	53,746	53,746
R-squared	.461	.612	.317	.112	.119	.124	.24
Panel B: Active Investors - Narrow frame for neutral types							
DAX down ×	-0.045***	-0.166***	-0.309***	-0.012	-0.018	-0.098	-0.211*
Extrapolator (diff. $\geq$ 3)	(0.016)	(0.052)	(0.106)	(0.010)	(0.017)	(0.078)	(0.120)
DAX down ×	-0.008	-0.021	-0.100	-0.009	-0.011	-0.055	-0.046
Neutral (-3 $\leq$ diff. $<$ 3)	(0.013)	(0.042)	(0.085)	(0.008)	(0.014)	(0.063)	(0.088)
Observations	53,746	53,746	53,746	53,746	53,746	53,746	53,746
R-squared	.461	.612	.317	.112	.119	.124	.24
Panel C: Active Investors - Broad frame for neutral types							
DAX down ×	-0.036**	-0.145**	-0.259**	-0.022**	-0.025	-0.169*	-0.090
Extrapolator (diff. $\geq$ 5)	(0.018)	(0.065)	(0.120)	(0.011)	(0.018)	(0.086)	(0.134)
DAX down ×	-0.014	-0.055	-0.150**	-0.001	0.008	0.014	-0.163**
Unbiased (-5 $\leq$ diff. $<$ 5)	(0.010)	(0.037)	(0.070)	(0.007)	(0.012)	(0.052)	(0.070)
Observations	53,746	53,746	53,746	53,746	53,746	53,746	53,746
R-squared	.461	.612	.317	.112	.119	.124	.24
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table examines the association between beliefs about the autocorrelation of aggregate returns and trading activity at the online bank based on investor-month level estimations of specification 1 for alternative definitions of belief types. Panel A repeats the results based on the baseline type definition from Table 3 Panel C. In Panel B, we use a more narrow cutoff to define neutrals (difference in estimated returns for the following year between positive and negative previous return scenarios of at least -3 percentage points and lower than 3 percentage points). In Panel C, we use a broader definition of neutrals (difference at least -5 percentage points and lower than 5 percentage points). Columns 1-3 focus on the buying side, Columns 4-6 on the selling side, and Column 7 on net buying. Specifically, prob(buy) (prob (sale)) is an indicator for whether the respondent conducts one or more equity purchases (sales) during a given month, number of purchases (number of sales) is the number of buying (selling) transactions in equities in a given month, and log buying (selling) volume is the log of the overall transaction value of all equity purchases (sales) in a given month, where the value one is added to the volume before taking logs. DAX down is a dummy indicating whether the return of the DAX over the preceding 12 months was negative. For the return calculation, we use the average return compared to 12 months earlier across all trading days in the current month. The transaction data span the period from December 2014 until the month before the survey month (between September and November 2019) for the treatment group and until including January 2020 for the control group. The estimations focus on the subsample of active investors, where the lowest quartile in terms of the number of trades over the previous 12 months is excluded. All estimations include individual and month-year fixed effects as well as lagged log financial wealth held with the bank. Standard errors are two-way clustered by investor and trading month and are presented in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.4: Manipulation check: Alternative type definitions

	No sense to buy after high return	Positive return more likely after high return	Above average return after negative return	Negative return likely to continue next year
	(1)	(2)	(3)	(4)
Panel A: Baseline				
Treatment × Extrapolator (diff. $\geq$ 4) (a)	0.021 (0.114)	-0.375*** (0.115)	-0.382** (0.176)	-0.916*** (0.189)
Treatment × Neutral (-4 $\leq$ diff. $<$ 4)	0.075 (0.080)	-0.084 (0.081)	0.088 (0.123)	-0.274** (0.115)
Treatment × Mean-reverter (diff. $<$ -4) (b)	-0.155*** (0.060)	-0.114* (0.062)	-0.556*** (0.087)	-0.428*** (0.086)
p-value (a=b)	0.174	0.047	0.379	0.019
Panel B: Neutral narrow				
Treatment × Extrapolator (diff. $\geq$ 3) (a)	0.076 (0.109)	-0.327*** (0.112)	-0.357** (0.170)	-0.823*** (0.179)
Treatment × Neutral (-3 $\leq$ diff. $<$ 3)	-0.041 (0.091)	-0.076 (0.092)	0.129 (0.137)	-0.232* (0.130)
Treatment × Mean-reverter (diff. $<$ -3) (b)	-0.101* (0.057)	-0.117** (0.059)	-0.504*** (0.084)	-0.437*** (0.083)
p-value (a=b)	0.151	0.099	0.442	0.051
Panel C: Neutral broad				
Treatment × Extrapolator (diff. $\geq$ 5) (a)	0.024 (0.123)	-0.432*** (0.119)	-0.476** (0.188)	-0.902*** (0.201)
Treatment × Neutral (-5 $\leq$ diff. $<$ 5)	0.034 (0.073)	-0.093 (0.074)	0.058 (0.111)	-0.329*** (0.108)
Treatment × Mean-reverter (diff. $<$ -5) (b)	-0.151** (0.062)	-0.106 (0.066)	-0.586*** (0.091)	-0.430*** (0.089)
p-value (a=b)	0.206	0.017	0.602	0.032

Notes: This table shows estimations of the effect of the information treatment on respondents' posterior agreement to verbal statements describing beliefs about the autocorrelation of aggregate returns for alternative definitions of belief types. Agreement to the statements is elicited on 7-point categorical scales, and is z-scored using the means and standard deviations in the sample. The statements are: "When the stock market has recently increased it makes no sense to buy stocks." (Column 1); "When the stock market has recently increased it is more likely that stock returns will be positive over the following time than when the stock market has recently decreased." (Column 2); "When the stock market has fallen in the previous year one can expect above-average returns for the next year." (Column 3); "When the stock market has fallen over the previous 12 months there is a high probability that this trend will continue in the following 12 months." (Column 4). The outcomes in Columns 1 and 2 are elicited in the main survey and the outcomes in Columns 3 and 4 are elicited in the follow-up survey after the repeated information treatment. The estimations show heterogeneous treatment effects for prior extrapolators, neutrals, and mean reverters. Panel A repeats the results based on the baseline type definition from Table 5. In Panel B, we use a more narrow cutoff to define neutrals (difference in estimated returns for the following year between positive and negative previous return scenarios of at least -3 percentage points and lower than 3 percentage points). In Panel C, we use a broader definition of neutrals (difference at least -5 percentage points and lower than 5 percentage points). All estimations include the baseline set of controls described in Appendix A as well as non-interacted dummies for extrapolators and mean reverters using the relevant definition. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.5: Recall of treatment information in four-week follow-up

	Δ Estimated historical mean return next 12 months conditional on return previous 12 months in interval						Δ Perceived SD	Δ Perceived diff. gain-loss
	(1) ≤ −20%	(2) [-20%,-10%]	(3) [-10%,0%]	(4) [0%,10%]	(5) [10%,20%]	(6) >20%	(7)	(8)
Treatment × (Information - Prior)	0.277*** (0.054)	0.132** (0.063)	0.020 (0.076)	0.319*** (0.109)	0.260*** (0.060)	0.252*** (0.054)	0.293*** (0.068)	0.317*** (0.057)
Treatment	-0.594 (0.571)	-0.986* (0.515)	-0.723* (0.401)	-0.766* (0.457)	0.384 (0.427)	0.888* (0.527)	0.575 (0.454)	-0.826 (0.572)
Information - Prior	0.495*** (0.041)	0.610*** (0.043)	0.759*** (0.052)	0.521*** (0.091)	0.567*** (0.046)	0.531*** (0.040)	0.536*** (0.047)	0.420*** (0.043)
Observations	903	899	900	903	903	902	903	903
R-squared	0.45	0.43	0.41	0.30	0.45	0.48	0.46	0.40

Notes: This table examines whether respondents recall the treatment information in the four-week follow-up. The outcomes are differences between respondents' posterior beliefs measured in the four-week follow-up survey and prior beliefs measured in the main survey. The beliefs are the perceived historical average 12 months-ahead return when the return over the previous 12 months fell into one of six intervals (Columns 1-6), the perceived standard deviation of year-ahead returns over the six historical realized return intervals (Column 7), and the perceived difference in average year-ahead returns between the positive and the negative realized return scenarios (Column 8). Changes in beliefs are regressed on a treatment indicator, the difference between information and prior, and the difference between information and prior interacted with a treatment indicator (indicating whether respondents actually received the information). Changes in beliefs and differences between information and prior are winsorized at -20 and 20 percentage points. All estimations include the baseline set of controls described in Appendix A as well as dummies for the time between main and follow-up survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.6: Manipulation check: Persistence in four-week follow-up

	Main survey		Main survey Follow-up sample		Follow-up survey	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Positive return irrespective of previous return						
Treatment	0.093**		0.107*		0.116*	
	(0.044)		(0.065)		(0.067)	
Treatment ×		0.166***		0.163*		0.209**
Perceived SD ≥ Median		(0.062)		(0.092)		(0.097)
Treatment ×		0.020		0.053		0.025
Perceived SD < Median		(0.062)		(0.089)		(0.091)
Observations	1,961	1,961	903	903	903	903
Panel B: No sense to buy after high return						
Treatment	-0.054		-0.050		-0.135**	
	(0.044)		(0.063)		(0.068)	
Treatment ×		0.021		-0.133		-0.259
Extrapolator (diff. ≥ 4)		(0.114)		(0.174)		(0.177)
Treatment ×		0.075		0.025		0.030
Neutral (-4 ≤ diff. < 4)		(0.080)		(0.112)		(0.118)
Treatment ×		-0.155***		-0.072		-0.199**
Mean-reverter (diff. < -4)		(0.060)		(0.084)		(0.094)
Observations	1,961	1,961	903	903	903	903
Panel C: Positive return more likely after high return						
Treatment	-0.147***		-0.100		0.031	
	(0.045)		(0.069)		(0.067)	
Treatment ×		-0.375***		-0.610***		-0.026
Extrapolator (diff. ≥ 4)		(0.115)		(0.184)		(0.179)
Treatment ×		-0.084		-0.011		0.058
Neutral (-4 ≤ diff. < 4)		(0.081)		(0.119)		(0.120)
Treatment ×		-0.114*		-0.010		0.031
Mean-reverter (diff. < -4)		(0.062)		(0.093)		(0.091)
Observations	1,961	1,961	903	903	903	903

Notes: This table shows persistence of treatment effects on respondents' posterior agreement to verbal statements describing beliefs about the autocorrelation of aggregate returns in the four-week follow-up survey. Agreement to the statements is elicited on 7-point categorical scales, and is z-scored using the means and standard deviations in the sample. The statements are: "With an investment in stocks one can expect a positive return, independently of how the stock market has developed in the recent past." (Panel A); "When the stock market has recently increased it makes no sense to buy stocks." (Panel B); "When the stock market has recently increased it is more likely that stock returns will be positive over the following time than when the stock market has recently decreased." (Panel C). Columns 1-2 focus on responses in the main survey using the full sample. Columns 3-4 focus on responses in the main survey using those who completed the follow-up. Columns 5-6 focus on responses in the four-week follow-up. Panel A Columns 2, 4 and 6 show heterogeneous treatment effects by holding an above or below median prior perceived standard deviation of year-ahead returns over the six historical realized return intervals. Panels B and C Columns 2, 4 and 6 show heterogeneous treatment effects for prior extrapolators (perceived difference in average year-ahead returns between the positive and the negative realized return scenarios at least 4 percentage points,), neutrals (difference at least -4 and less than 4 percentage points), and mean reverters (difference less than -4 percentage points). All estimations include the baseline set of controls described in Appendix A. Columns 3-6 additionally control for dummies indicating the time between main and follow-up survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.7: Trading behavior during the COVID-19 downturn: Full sample

	Purchases			Sales			Net purchases
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Prob (buy)	# of purchases	Log buying volume	Prob (sell)	# of sales	Log selling volume	Net log buying
Panel A: Sample of non-treated investors							
Covid-19 × Mean Reverter	0.016	0.145***	0.205	0.016	0.059***	0.111	0.094
	(0.014)	(0.054)	(0.133)	(0.015)	(0.020)	(0.127)	(0.141)
Post × Mean Reverter	-0.031*	-0.053	-0.148	0.015	0.026	0.142	-0.291*
	(0.017)	(0.065)	(0.140)	(0.017)	(0.026)	(0.131)	(0.162)
Observations	40,636	40,636	40,636	40,636	40,636	40,636	40,636
R-squared	.475	.582	.335	.101	.099	.112	.244
Panel B: Treatment effects - Mean Reverter							
Covid-19 × Treatment	0.004	-0.102***	-0.086	-0.028*	-0.070***	-0.195*	0.109
	(0.007)	(0.035)	(0.100)	(0.014)	(0.025)	(0.110)	(0.134)
Post × Treatment	0.003	-0.082	-0.000	0.007	0.006	0.060	-0.060
	(0.012)	(0.051)	(0.111)	(0.015)	(0.024)	(0.103)	(0.103)
Observations	45,783	45,783	45,783	45,783	45,783	45,783	45,783
R-squared	.486	.626	.364	.107	.11	.118	.251
Panel C: Treatment effects - Non Mean Reverter							
Covid-19 × Treatment	0.014	-0.023	0.119	-0.003	0.005	-0.030	0.149
	(0.015)	(0.037)	(0.119)	(0.014)	(0.031)	(0.102)	(0.159)
Post × Treatment	-0.005	-0.066	-0.005	0.020	0.014	0.165	-0.170
	(0.016)	(0.051)	(0.132)	(0.017)	(0.024)	(0.126)	(0.183)
Observations	36,376	36,376	36,376	36,376	36,376	36,376	36,376
R-squared	.484	.583	.354	.121	.132	.129	.241
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table examines the association between beliefs about the autocorrelation of aggregate returns and trading activity during the COVID-19 crash (Panel A) and the effect our information treatment on trading activity during the crash among different groups (Panels B and C) based on investor-month level estimations of specifications 4 and 5. The samples are based on the full samples of relevant investors. Columns 1-3 focus on the buying side, Columns 4-6 on the selling side, and Column 7 on net buying. Specifically, prob(buy) (prob (sale)) is an indicator for whether the respondent conducts one or more equity purchases (sales) during a given month, number of purchases (number of sales) is the number of buying (selling) transactions in equities in a given month, and log buying (selling) volume is the log of the overall transaction value of all equity purchases (sales) in a given month, where the value one is added to the volume before taking logs. The transaction data span the period from December 2014 until March 2020. Panel A reports the effects of differences in beliefs about the autocorrelation of aggregate returns (mean reverters vs. non-mean reverters) for the sample of non-treated investors. Panel B reports effects of our information treatment for the subsample of investors characterized as being mean reverters (for whom the prior perceived difference in average year-ahead returns between the positive and the negative realized return scenarios is less than -4 percentage points). Panel C reports effects of our information treatment for non-mean reverters (difference -4 percentage points or higher). All specifications control for month-year as well as individual fixed effects and lagged log financial wealth held with the bank. Standard errors are two-way clustered by investor and trading month and are presented in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.8: Trading behavior of mean reverters during the COVID-19 downturn: Alternative type definitions

	Purchases			Sales			Net purchases
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Prob (buy)	# of purchases	Log buying volume	Prob (sell)	# of sales	Log selling volume	Net log buying
Panel A: Treatment effects - Mean Reverter (diff. $\leq$ -4)							
Covid-19 × Mean Reverter	-0.020**	-0.155***	-0.285**	-0.029*	-0.075**	-0.192	-0.093
	(0.009)	(0.049)	(0.127)	(0.017)	(0.033)	(0.137)	(0.188)
Post × Mean Reverter	-0.007	-0.134*	-0.071	0.013	0.022	0.090	-0.161
	(0.016)	(0.071)	(0.139)	(0.017)	(0.031)	(0.122)	(0.131)
R-squared	32,859	32,859	32,859	32,859	.107	.117	.242
Observations	.462	.623	.326	.104	32859	32859	32859
Panel B: Treatment effects - Mean Reverter (diff. $\leq$ -3)							
Covid-19 × Treatment	-0.021**	-0.163***	-0.283**	-0.030*	-0.071**	-0.198	-0.108
	(0.009)	(0.043)	(0.127)	(0.017)	(0.033)	(0.127)	(0.137)
Post × Treatment	-0.006	-0.140**	-0.077	0.007	0.018	0.054	-0.105
	(0.017)	(0.069)	(0.148)	(0.016)	(0.031)	(0.116)	(0.149)
R-squared	36,125	36,125	36,125	36,125	.11	.12	.243
Observations	.47	.633	.336	.104	36125	36125	29845
Panel C: Treatment effects - Mean Reverter (diff. $\leq$ -5)							
Covid-19 × Treatment	-0.027**	-0.194***	-0.357***	-0.036**	-0.099***	0.087	-0.085
	(0.011)	(0.044)	(0.115)	(0.016)	(0.030)	(0.105)	(0.155)
Post × Treatment	-0.005	-0.110	-0.030	0.009	0.013	0.135	-0.131
	(0.017)	(0.070)	(0.138)	(0.020)	(0.033)	(0.106)	(0.125)
R-squared	29,845	29,845	29,845	29,845	.111	.128	.252
Observations	.453	.616	.319	.107	29845	28169	36125
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table examines the effect of our information treatment on trading activity of mean reverters during the COVID-19 crash based on investor-month level estimations of specification 5 for alternative definitions of mean reverters. Panel A repeats the results based on the baseline type definition from Table 7 Panel B. In Panel B, we use a wider definition of mean reverters (difference in estimated returns for the following year between positive and negative previous return scenarios lower than -3 percentage points). In Panel C, we use a more narrow definition of mean reverters (difference lower than -5 percentage points). The samples are restricted to active investors, i.e. those in the lowest quartile of number of trades over the 12 months before the survey are excluded. Columns 1-3 focus on the buying side, Columns 4-6 on the selling side, and Column 7 on net buying. Specifically, prob(buy) (prob (sale)) is an indicator for whether the respondent conducts one or more equity purchases (sales) during a given month, number of purchases (number of sales) is the number of buying (selling) transactions in equities in a given month, and log buying (selling) volume is the log of the overall transaction value of all equity purchases (sales) in a given month, where the value one is added to the volume before taking logs. The transaction data span the period from December 2014 until March 2020. All specifications control for month-year as well as individual fixed effects and lagged log financial wealth held with the bank. Standard errors are two-way clustered by investor and trading month and are presented in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

E Survey instructions translated to English

E.1 Main survey

Welcome screen

Welcome to the survey from Goethe University!

Many thanks for answering our questions on the investment behavior of retail investors.

Completion of the survey takes *about 15 minutes*. Your participation is of course anonymous. Your responses will only be used for scientific research.

In return for completing the survey you will receive an *Amazon voucher of 10 euros*. You will receive more detailed information on this during the survey.

To receive a voucher, please leave your email address at the end of the survey. We will send you your voucher code within the next days by email. Your email address will be saved separately from your responses in the survey, and will be deleted after we have sent out the voucher. You can learn more under our information on data protection.

Hint: The survey contains graphics that cannot be optimally displayed on smartphones. We therefore ask you to complete the survey *using a computer or a tablet* if possible.

Do you have questions? Please contact us under umfrage@finance.uni-frankfurt.de

Attention check

The next question is about the following problem. In questionnaires like ours there are sometimes participants who do not read the questions carefully and only quickly "click" through the questionnaire. This results in many random answers, which compromise the quality of research studies.

To show us that you read our questions carefully, please select "Very interested" and "Not at all interested" as your answer to the next question.

How interested are you in sports?

Very strongly interested - Strongly interested - Somewhat interested - Almost not interested - Not at all interested

Perceived recent stock market return

Let us think about the *last 12 months*.

What do you think, what was the return (in percent) of the DAX over the *last 12 months*?

The return is the percent change in value of an investment in the DAX over the last 12 months. A positive number indicates that the value of the DAX has increased, a negative number indicates that the value has decreased.

__ percent

According to your estimate, an investor who 12 months ago invested 100 euro in the DAX would own X euro today.

How certain are you about your response?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Prior expected future stock market return

Let us now think about the future. What do you think, what will the return (in percent) of the DAX be over the *next 12 months*?

The return is the percent change in value of an investment in the DAX over the next 12 months. A positive number indicates that the value of the DAX increases, a negative number indicates that the value decreases.

__ percent

According to your estimate, an investor who today invests 100 euro in the DAX would own X euro 12 months from now.

How certain are you about your response?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Transition to main belief elicitation

On the following pages we would like to ask you about your estimates of the return of the DAX under *six different scenarios*.

Please take a moment to read the questions carefully. High attention in responding to the questions is essential for the quality of the results of this study.

Hint: Each question will be shown to you only once, and you will not be able to go back to previous questions later on.

Prior belief about historical autocorrelation of stock returns (quantitative): Return below -20 percent

First think about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *less than -20 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

The blue bar in the figure below illustrates your response.

__ percent

Prior belief about historical autocorrelation of stock returns (quantitative): Return between -20 and -10 percent

Please think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between -20 and -10 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Prior belief about historical autocorrelation of stock returns (quantitative): Return between -10 and 0 percent

Please think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between -10 and 0 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Prior belief about historical autocorrelation of stock returns (quantitative): Return between 0 and 10 percent

Please think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between 0 and 10 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Prior belief about historical autocorrelation of stock returns (quantitative): Return between 10 and 20 percent

Think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between 10 and 20 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Prior belief about historical autocorrelation of stock returns (quantitative): Return above 20 percent

Think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *above 20 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Transition to information treatment [Treatment group only]

On the next screen we will provide you with information on the *actual average returns* of the DAX in the different cases.

Please take a moment to read the information carefully.

Hint: The information will be shown to you only once and you will not be able to go back to the information.

Information treatment screen 1 [Treatment group only]

The figure below shows you the *actual average returns* of the DAX over the *following 12 months*, depending on what the return was over the *preceding 12 months*.

The figure is based on the returns of the DAX over the last 50 years.

Through repeated clicking on the button below you will be shown the actual average returns in the different scenarios. *Only when you have seen the actual average returns in all six scenarios will you be allowed to proceed with the survey.*

Information treatment screens 1a-1f [Treatment group only]

The figure below shows you the *actual average returns* of the DAX over the *following 12 months*, depending on what the return was over the *preceding 12 months*.

The figure is based on the returns of the DAX over the last 50 years.

Through repeated clicking on the button below you will be shown the actual average returns in the different scenarios. *Only when you have seen the actual average returns in all six scenarios will you be allowed to proceed with the survey.*

When the return over the preceding 12 months was below -20%, the return over the following 12 months was *9.5%* on average (your estimate: *A%*).

When the return over the preceding 12 months was between -20% and -10%, the return over the following 12 months was *7.4%* on average (your estimate: *B%*).

When the return over the preceding 12 months was between -10% and 0%, the return over the following 12 months was *9.5%* on average (your estimate: *C%*).

When the return over the preceding 12 months was between 0% and 10%, the return over the following 12 months was *8.8%* on average (your estimate: *D%*).

When the return over the preceding 12 months was between 10% and 20%, the return over the following 12 months was *8.7%* on average (your estimate: *E%*).

When the return over the preceding 12 months was above 20%, the return over the following 12 months was *8.1%* on average (your estimate: *F%*).

Information treatment screen 2 [Treatment group only]

Independently of the interval in which the return over the preceding 12 months was, the return of the DAX over the following 12 months was on average always between 7.4% and 9.5%.

This means that *regardless of the return of the DAX* over a particular year the *best forecast* of the return over the following year is close to the long-run historical mean return of *8.5%*.

High or low stock market returns over a particular year hence do not allow to make a prediction about stock market returns over the following year.

Imagine one could predict at which point stock prices would increase by more than on average. Large institutional investors would then buy securities in large amounts. This would put stock prices under upward pressure. The possibility to predict higher-than-average returns would vanish immediately.

Control group information screen [Control group only]

Think now about the development of the DAX in the last 50 years. The average annual return of the DAX over this time period was

8.5 percent per year.

Posterior beliefs about autocorrelation of stock returns (qualitative)

To what extent do you agree with the following statements?

"With an investment in stocks one can expect a positive return, independently of how the stock market has developed in the recent past."

"When the stock market has recently increased it makes no sense to buy stocks."

"When the stock market has recently increased it is more likely that stock returns will be positive over the following time than when the stock market has recently decreased."

1 (strongly disagree) - 2 - 3 - 4 - 5 - 6 - 7 (strongly agree)

Posterior expected future stock market return

Let us again think about the *next 12 months*. What do you think, what will the return (in percent) of the DAX be over the *next 12 months*?

__ percent

According to your estimate, an investor who today invests 100 euro in the DAX would own X euro 12 months from now.

Please explain your response in 1-2 sentences.

—

Posterior expected future stock market return: Subjective distribution

In the following we show you *6 possible scenarios* on how the DAX might develop over the *coming 12 months.*

Please indicate how likely you consider each scenario to be.

To do this, assign a probability to each scenario. The probabilities across the six scenarios have to sum to 100 percent.

Scenario 1: A return greater than 20%: __ percent

Scenario 2: A return between 10% and 20%: __ percent

Scenario 3: A return between 0% and 10%: __ percent

Scenario 4: A return between -10% and 0%: __ percent

Scenario 5: A return between -20% and -10%: __ percent

Scenario 6: A return less than -20 %: __ percent

How certain are you about your response?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Advanced financial literacy test

At the end we would like to ask you a few general questions.

What happens with the price of a bond if interest rates increase.

Rises - Falls - Remains unchanged - I do not know.

Which of the following statements is correct? If someone buys a stock of company B, then ...

... he owns a share in this company. - ... he lends money to company B. - ... he is liable for the liabilities of company B. - No response is correct. - I do not know.

Is the following statement true or false? The value of a call option for a stock is - everything else unchanged - higher, the more volatile the stock is.

True - False - I do not know.

How many of these questions have you answered correctly?

__

Background questions I

To what extent to you agree with the following statement? *"I closely follow the development of the DAX."*

1 (strongly disagree) - 2 - 3 - 4 - 5 - 6 - 7 (strongly agree)

What information sources do you typically use before securities purchases / sales?

General news (e.g. newspapers, TV) - Specialized press (e.g. investment magazines) - Own online research - Chart analysis - Securities rankings (e.g. daily top ten) - I mostly trade with securities I already have / had in my portfolio - Recommendation from family / friends / acquaintances - Recommendation from a financial advisor - Recent stock price development - Other: __

How difficult have you found the questions in this survey?

1 (not difficult at all) - 2 - 3 - 4 - 5 - 6 - 7 (very difficult)

Have you looked up additional information to answer the survey (e.g. google)?

No - Yes, namely: __

Background questions II

For how many years have you been investing in stocks or stock mutual funds?

Enter 0 if you have no experience with investment in stocks or stock mutual funds.

For __ years.

When you personally make saving or investment decisions, how would you generally describe your *attitude toward risk*?

1 (not at all willing to take risks) - 2 - 3 - 4 - 5 - 6 - 7 (very willing to take risks)

How often do you trade with stocks on average?

Daily - Weekly - Once or twice per month - Once or twice per quarter - Once or twice per year - Less than once a year

What is your typical *investment horizon* for securities investments?

Less than 3 months - 3-12 months - 1-3 years - 3-5 years - 5-10 years - Longer than 10 years

Background questions III

What is your current *employment status*?

Full-time employed (including apprenticeships) - Part-time employed - Temporary leave (e.g. parental leave) - In school, university or unpaid internship - Unemployed - Permanent leave - Retired - Housekeeper - Other: __

Which of the following categories best describes your household's monthly *available net income*?

In your response, please account for all income of your household (e.g. also income from letting or leasing and child allowance). By household we mean all family members living with you at your main residence, excluding renters and flat mates.

[Categories]

Into which of the following categories falls your household's *net wealth*?

The net wealth is the value of everything the household members own (e.g. real estate, vehicles, financial assets, insurances) minus all liabilities (e.g. credit, loans, mortgages).

[Categories]

Background questions IV

Please indicate your gender.

Female - Male

In which year where you born?

[Dropdown menu]

What is your highest *educational attainment*?

Secondary school qualification - Secondary school certificate - Higher education entrance qualification - Higher education degree - No school-leaving qualification - Other: __

Technical questions

On which device have you filled out the questionnaire?

PC, laptop or tablet - Smartphone - Other: __

Did you experience a *technical issue* during the survey?

Yes - No.

Feedback questions

Did you have difficulties understanding one or more questions in this survey?

Yes - No

Do you have any suggestions or criticism related to our survey? Please let us know here (optional):

—

Payment and invitation to follow-up survey

Many thanks!

As a thank you for your responses you receive and *Amazon voucher of 10 EUR*.

If you would like to receive the voucher, you simply have to confirm this below and in a next step provide a valid email address. The voucher codes will be sent by email within the next 2 weeks.

Yes, I would like to receive a voucher code by email. - No, I would not like to receive a voucher code by email.

Are you interested in participating in a *follow-up survey*?

We would be happy to invite you to it by email.

Of course, we also reward participation in follow-up surveys with a bonus.

Yes, please invite me to a follow-up survey. - No, please do not invite me to a follow-up survey.

Please enter a *valid email address*:

Of course we will not give your email address to the bank or to third parties. Contacting you by email will be exclusively done to send you the voucher and / or invite you to a follow-up survey. After completion of this study your email address will be immediately deleted.

—

Goodbye screen

Many thanks for your participation!

You receive your *Amazon voucher of 10 EUR* in return for your participation *within the coming 2 weeks* by email.

E.2 Follow-up survey

Welcome screen

Welcome to the survey from Goethe University!

Many thanks for again taking the time to respond to our questions.

Completion of the survey takes *about 10 minutes*. Your participation is of course anonymous. Your responses will only be used for scientific research.

In return for completing the survey you will receive an *Amazon voucher of 5 euros*. We will send you your voucher code within the next days by email. Your email address will be saved separately from your responses in the survey, and will be deleted after we have sent out the voucher. You can learn more under our information on data protection.

Hint: The survey contains graphics that cannot be optimally displayed on smartphones. We therefore ask you to complete the survey *using a computer or a tablet* if possible.

Do you have questions? Please contact us under umfrage@finance.uni-frankfurt.de

Posterior expected future stock market return I

Let us now think about the future. What do you think, what will the return (in percent) of the DAX be over the *next 12 months*?

The return is the percent change in value of an investment in the DAX over the next 12 months. A positive number indicates that the value of the DAX increases, a negative number indicates that the value decreases.

__ percent

According to your estimate, an investor who today invests 100 euro in the DAX would own X euro 12 months from now.

How certain are you about your response?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Posterior expected future stock market return: Subjective distribution

In the following we show you *6 possible scenarios* on how the DAX might develop over the *coming 12 months*.

Please indicate how likely you consider each scenario to be.

To do this, assign a probability to each scenario. The probabilities across the six scenarios have to sum to 100 percent.

Scenario 1: A return greater than 20%: __ percent

Scenario 2: A return between 10% and 20%: __ percent

Scenario 3: A return between 0% and 10%: __ percent

Scenario 4: A return between -10% and 0%: __ percent

Scenario 5: A return between -20% and -10%: __ percent

Scenario 6: A return less than -20 %: __ percent

How certain are you about your response?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Posterior beliefs about autocorrelation of stock returns (qualitative) I

To what extent do you agree with the following statements?

"With an investment in stocks one can expect a positive return, independently of how the stock market has developed in the recent past."

"When the stock market has recently increased it makes no sense to buy stocks."

"When the stock market has recently increased it is more likely that stock returns will be positive over the following time than when the stock market has recently decreased."

1 (strongly disagree) - 2 - 3 - 4 - 5 - 6 - 7 (strongly agree)

Transition to main belief elicitation

On the following pages we would like to ask you about your estimates of the return of the DAX under *six different scenarios*.

Please take a moment to read the questions carefully. High attention in responding to the questions is essential for the quality of the results of this study.

Hint: Each question will be shown to you only once, and you will not be able to go back to previous questions later on.

Posterior belief about historical autocorrelation of stock returns (quantitative): Return below -20 percent

First think about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *less than -20 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

The blue bar in the figure below illustrates your response.

__ percent

Posterior belief about historical autocorrelation of stock returns (quantitative): Return between -20 and -10 percent

Please think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between -20 and -10 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Posterior belief about historical autocorrelation of stock returns (quantitative): Return between -10 and 0 percent

Please think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between -10 and 0 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Posterior belief about historical autocorrelation of stock returns (quantitative): Return between 0 and 10 percent

Please think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between 0 and 10 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Posterior belief about historical autocorrelation of stock returns (quantitative): Return between 10 and 20 percent

Think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *between 10 and 20 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Posterior belief about historical autocorrelation of stock returns (quantitative): Return above 20 percent

Think now about *all points in time* in the last 50 years at which the return of the DAX over the *preceding 12 months* was *above 20 percent*.

What do you think, what was the return of the DAX in these cases on average over the *immediately following 12 months*?

__ percent

Posterior belief about historical autocorrelation of stock returns (quantitative): Confidence

How confident are you about your responses in the six scenarios?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Perceived recent stock market return

Let us think about the *last 12 months*.

What do you think, what was the return (in percent) of the DAX over the *last 12 months*?

The return is the percent change in value of an investment in the DAX over the last 12 months. A positive number indicates that the value of the DAX has increased, a negative number indicates that the value has decreased.

__ percent

According to your estimate, an investor who 12 months ago invested 100 euro in the DAX would own X euro today.

How certain are you about your response?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Transition to repeated information treatment [Treatment group only]

On the next screen we will provide you with information on the *actual average returns* of the DAX in the different cases.

Please take a moment to read the information carefully.

Hint: The information will be shown to you only once and you will not be able to go back to the information.

Repeated information treatment screen 1 [Treatment group only]

The figure below shows you the *actual average returns* of the DAX over the *following 12 months*, depending on what the return was over the *preceding 12 months*.

The figure is based on the returns of the DAX over the last 50 years.

Through repeated clicking on the button below you will be shown the actual average returns in the different scenarios. *Only when you have seen the actual average returns in all six scenarios will you be allowed to proceed with the survey.*

Repeated information treatment screens 1a-1f [Treatment group only]

The figure below shows you the *actual average returns* of the DAX over the *following 12 months*, depending on what the return was over the *preceding 12 months*.

The figure is based on the returns of the DAX over the last 50 years.

Through repeated clicking on the button below you will be shown the actual average returns in the different scenarios. *Only when you have seen the actual average returns in all six scenarios will you be allowed to proceed with the survey.*

When the return over the preceding 12 months was below -20%, the return over the following 12 months was *9.5%* on average (your estimate: *A%*).

When the return over the preceding 12 months was between -20% and -10%, the return over the following 12 months was *7.4%* on average (your estimate: *B%*).

When the return over the preceding 12 months was between -10% and 0%, the return over the following 12 months was *9.5%* on average (your estimate: *C%*).

When the return over the preceding 12 months was between 0% and 10%, the return over the following 12 months was *8.8%* on average (your estimate: *D%*).

When the return over the preceding 12 months was between 10% and 20%, the return over the following 12 months was *8.7%* on average (your estimate: *E%*).

When the return over the preceding 12 months was above 20%, the return over the following 12 months was *8.1%* on average (your estimate: *F%*).

Repeated information treatment screen 2 [Treatment group only]

Independently of the interval in which the return over the preceding 12 months was, the return of the DAX over the following 12 months was on average always between 7.4% and 9.5%.

This means that *regardless of the return of the DAX* over a particular year the *best forecast* of the return over the following year is close to the long-run historical mean return of *8.5%*.

High or low stock market returns over a particular year hence do not allow to make a prediction about stock market returns over the following year.

Imagine one could predict at which point stock prices would increase by more than on average. Large institutional investors would then buy securities in large amounts. This would put stock prices under upward pressure. The possibility to predict higher-than-average returns would vanish immediately.

Control group repeated information screen [Control group only]

Think now about the development of the DAX in the last 50 years. The average annual return of the DAX over this time period was

8.5 percent per year.

Posterior beliefs about autocorrelation of stock returns (qualitative) II

To what extent do you agree with the following statements?

"When the stock market has fallen in the previous year one can expect above-average returns for the next year."

"When the stock market has fallen over the previous 12 months there is a high probability that this trend will continue in the following 12 months."

1 (strongly disagree) - 2 - 3 - 4 - 5 - 6 - 7 (strongly agree)

Posterior expected future stock market return II

Let us now think again about the *next 12 months*. What do you think, what will the return (in percent) of the DAX be over the *next 12 months*?

The return is the percent change in value of an investment in the DAX over the next 12 months. A positive number indicates that the value of the DAX increases, a negative number indicates that the value decreases.

__ percent

According to your estimate, an investor who today invests 100 euro in the DAX would own X euro 12 months from now.

Beliefs about historical frequencies of return scenarios

Think of all *12-month periods* in the *last 50 years*. Please give an estmate. In how many percent of cases did the DAX achieve a return in a given interval.

To do this, assign a response in percent to each scenario. The responses across the six scenarios have to sum to 100 percent.

Scenario 1: A return greater than 20%: __ percent

Scenario 2: A return between 10% and 20%: __ percent

Scenario 3: A return between 0% and 10%: __ percent

Scenario 4: A return between -10% and 0%: __ percent

Scenario 5: A return between -20% and -10%: __ percent

Scenario 6: A return less than -20 %: __ percent

How certain are you about your responses?

1 (not at all certain) - 2 - 3 - 4 - 5 - 6 - 7 (very certain)

Background questions I

Have you learned about topics related to *economics or business* in *school*?

Yes - No

Have you completed a *university degree* with focus on *economics or business*?

Please indicate your highest university degree with corresponding focus.

No, I have *not* completed a *university degree* with focus on economics or business. - Yes, I have completed a *Bachelor degree* with focus on economics or business. - Yes, I have completed a *Master degree* with focus on economics or business. - Yes, I have completed a *doctorate* with focus on economics or business.

Are you or have you been working in the financial sector?

Yes - No.

Background questions II

Did you follow the German stock market during the last 4 weeks?

not at all - a little bit - closely - very closely

To what extent do you agree with the following statement: "I always follow the development of the DAX."

1 (strongly disagree) - 2 - 3 - 4 - 5 - 6 - 7 (strongly agree)

On which device have you filled out the questionnaire?

PC, laptop or tablet - Smartphone - Other: __

Do you have any suggestions or criticism related to our survey? Please let us know here (optional):

—

Payment and invitation to future surveys

Many thanks!

As a thank you for your responses you receive and *Amazon voucher of 5 EUR.*

If you would like to receive the voucher, you simply have to confirm this below and in a next step provide a valid email address. The voucher codes will be sent by email within the next 2 weeks.

Yes, I would like to receive a voucher code by email. - No, I would not like to receive a voucher code by email.

Are you interested in participating in a *follow-up survey*?

We would be happy to invite you to it by email.

Of course, we also reward participation in follow-up surveys with a bonus.

Yes, please invite me to a follow-up survey. - No, please do not invite me to a follow-up survey.

Please enter a *valid email address*:

Of course we will not give your email address to the bank or to third parties. Contacting you by email will be exclusively done to send you the voucher and / or invite you to a follow-up survey. After completion of this study your email address will be immediately deleted.

—

Goodbye screen

Many thanks for your participation!

You receive your *Amazon voucher of 5 EUR* in return for your participation *within the coming 2 weeks* by email.