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

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Motivation

- Growing evidence on heterogeneity in the **subjective models of the economy** individuals rely on in their expectation formation.

  - Heterogeneity in beliefs about the **response** of the macroeconomy to **shocks** (Andre et al., 2021).

  - Underappreciation of **longer-run mean reversion** of local home prices (Armona et al., 2019).

  - Belief in a **non-zero autocorrelation** of aggregate stock returns, such as beliefs in **persistence** (Amromin and Sharpe, 2013; De Bondt, 1993; Greenwood and Shleifer, 2014) or beliefs in **mean reversion** (Dominitz and Manski, 2011; Heiss et al., 2019), although **empirically** the autocorrelation is close to zero.

- Heterogeneity in individuals' models of the world offers an explanation for **disagreement** in expectations about macroeconomic outcomes.

Research question

- Do differences in individuals' mental models causally lead to differences in **economic decisions**?

- We study this question in the context of **beliefs about the stock market**:
    - Strong **discrepancy** between individuals' mental models and empirical facts.
    - If subjective models affect trading decisions, this would suggest that heterogeneity in subjective models causally drives **trade in asset markets**.
    - **Increasing** stock market participation among households and rising importance of stock investments for retirement saving.

This paper

- **Survey experiment** with retail investors at a German online brokerage (n≈2,000; Response rate ≈ 16%).

  - Main survey and **four-week follow-up**; re-contact rate ≈ **58%**.
  - Linked to **administrative data** on their investment decisions before and after the intervention.

- We measure investors' beliefs about **time-series properties** of aggregate stock returns.

- We **inform** a **random subset** of respondents about the historical absence of predictive power of recently realized stock returns for future returns.

- We provide **correlational and causal** evidence on the role of the perceived autocorrelation of stock returns in expectation formation and trading decisions.

Preview of results

- Strong heterogeneity in beliefs, with a majority believing in **mean reversion** of aggregate returns.
    - More prevalent among more attentive, sophisticated, experienced or wealthy investors.

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- Respondents persistently **adjust their beliefs** about the autocorrelation of returns and their future return expectations in response to the information.

- Among those believing in mean reversion before the intervention, treated respondents buy significantly less equity during the **COVID-19 crash** four to five months later.

Related Literature

- Literature on formation of **subjective stock market expectations**
  Amromin and Sharpe (2013); Dominitz and Manski (2011); Greenwood and Shleifer (2014); Heiss et al. (2019)

- Literature on association between subjective return **expectations and investment behavior**
  Ameriks et al. (2020); Amromin and Sharpe (2013); Beutel and Weber (2021); Choi and Robertson (2020); Dominitz and Manski (2007); Giglio et al. (2021a,b)

- Literature using **information experiments** to study macroeconomic expectation formation
  Armantier et al. (2016); Armona et al. (2019); Cavallo et al. (2017); Coibion et al. (2021a,b); Fuster et al. (2018); Roth and Wohlfart (2020)

Outline of talk

Overview of main survey

1. Elicitation of **prior beliefs** about aggregate stock returns.
   - Return over past 12 months.
   - Return over next 12 months.
   - Historical autocorrelation of returns.

2. Randomized **information provision**.

3. Elicitation of **posterior beliefs** about aggregate stock returns.
   - Qualitative measures of perceived autocorrelation.
   - Return over next 12 months.

4. Background questions.

Elicitation of prior beliefs about autocorrelation
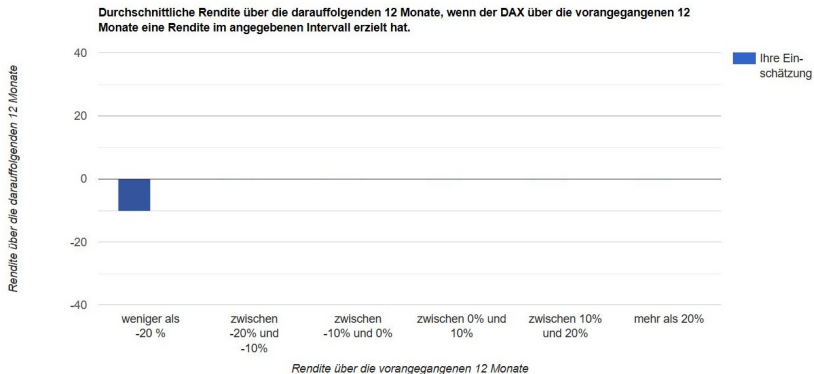
Notes: The figure shows the survey screen for eliciting prior beliefs about dependency of stock market returns (all respondents). Participants were asked to provide their perception of the 12-month ahead stock market return if the return over the previous 12 months falls within the respective bin. Each bin is asked about on a separate screen. The figure collects and displays answers made on previous bins.

Elicitation of prior beliefs about autocorrelation
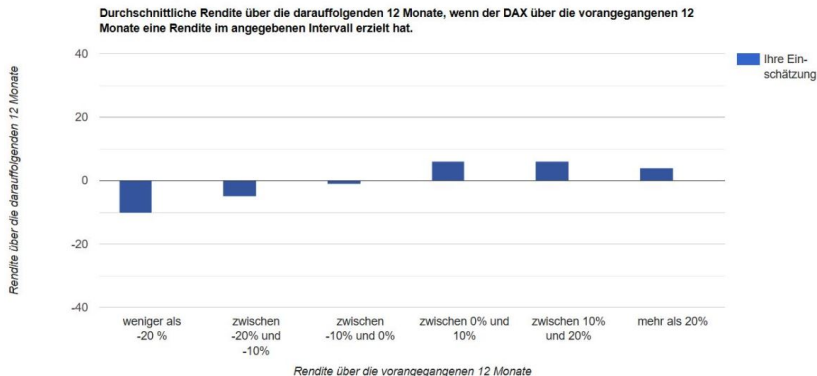
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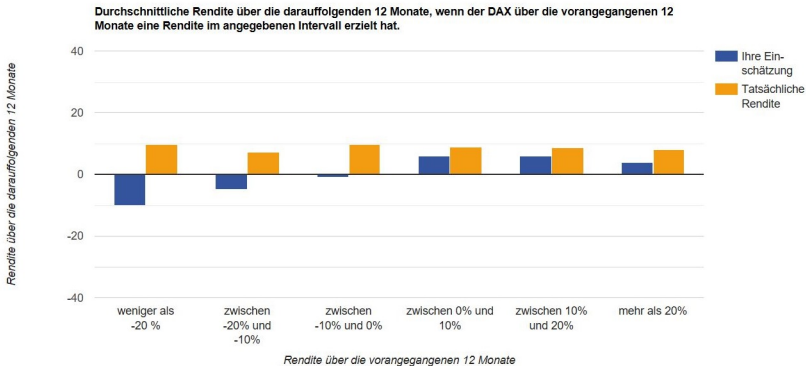
Information treatment

- Provision of actual average returns in the six scenarios to random half of the respondents. ▶ treatment text

Durchschnittliche Rendite über die darauffolgenden 12 Monate, wenn der DAX über die vorangegangenen 12 Monate eine Rendite im angegebenen Intervall erzielt hat.
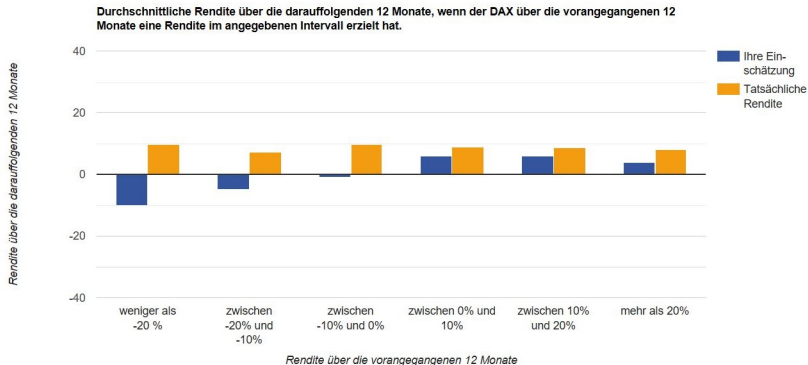
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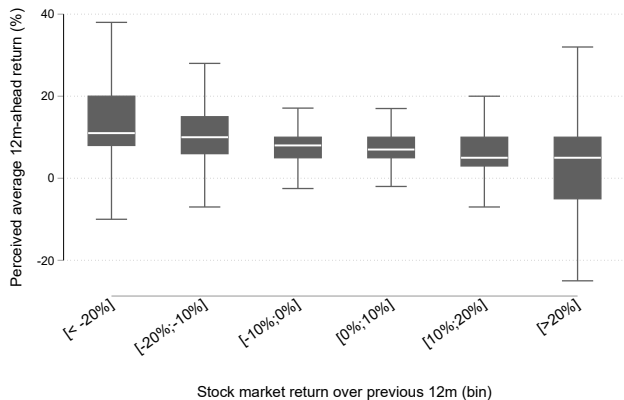
- Provision of overall average historical annual return on DAX to respondents in the control group ▸ control group

Outline of talk

Priors beliefs about autocorrelation of stock returns: Average beliefs

Stock market return over previous 12m (bin)

Notes: The figure shows box plots of the perceived 12-month ahead stock market return if the return over the previous 12 months falls within the respective bin.

Definition of belief types

Durchschnittliche Rendite über die darauffolgenden 12 Monate, wenn der DAX über die vorangegangenen 12 Monate eine Rendite im angegebenen Intervall erzielt hat.
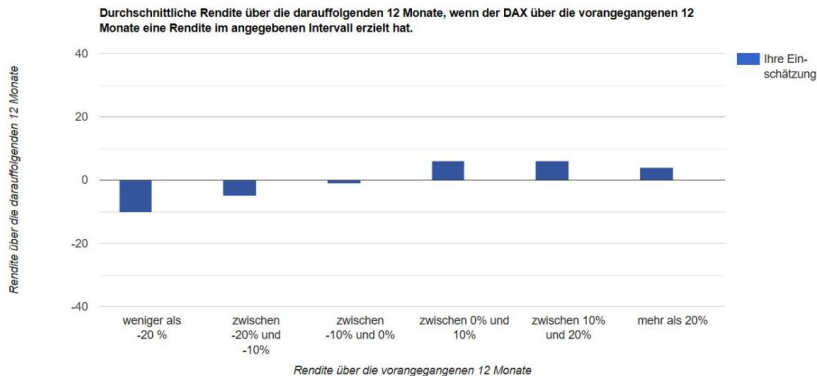
Define types based on prior perceived autocorrelation:
(robust to alternative definitions)

- **Extrapolator**: Perceived difference gain-loss ≥ 4
- **Neutral**: $-4 \leq$ diff. < 4
- **Mean-reverter**: Perceived difference gain-loss < -4

Priors beliefs about autocorrelation of stock returns: Types

Notes: The figure shows box plots of the perceived 12-month ahead stock market return if the return over the previous 12 months falls within the respective bin.
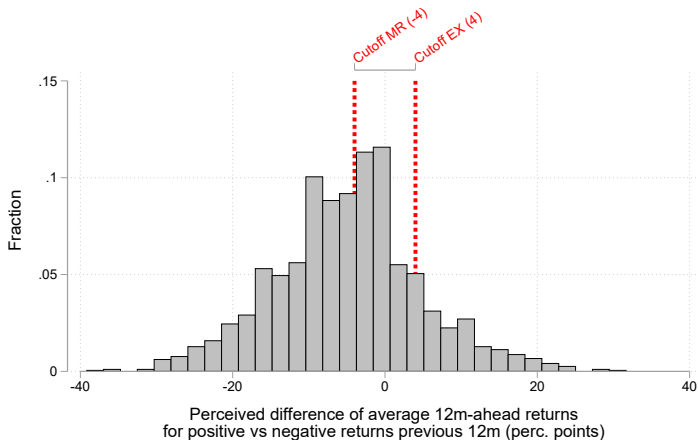
Correlates of beliefs

	Extra-polator (diff. $\geq$ 4)	Neutral (-4 $\leq$ diff. < 4)	Mean-reverter (diff. < -4)
	(1)	(2)	(3)
Log(Fin. wealth with bank)	-0.008	-0.011	0.018***
	(0.005)	(0.007)	(0.007)
Invest. experience $\geq$ Median	-0.038*	-0.056**	0.094***
	(0.021)	(0.027)	(0.028)
Full financial literacy score	-0.022	-0.052**	0.074***
	(0.019)	(0.025)	(0.028)
Follow DAX $\geq$ Median	-0.004	-0.067***	0.070***
	(0.017)	(0.022)	(0.024)
Controls	Yes	Yes	Yes
Observations	1,961	1,961	1,961
R-squared	0.03	0.02	0.04

Notes: Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and ***
at 1 pct. level.

Summary

Result 1:
There is strong heterogeneity in investors' perceived autocorrelation of returns, with a majority believing in mean reversion.

Perceived autocorrelation and trading

Do beliefs affect the timing of investors' trading decisions?

	Purchases			Sales			Net purchases
	(1)	(2)	(3) Log	(4)	(5)	(6) Log	(7)
	Prob (buy)	# of purchases	buying volume	Prob (sell)	# of sales	selling volume	Net log buying
DAX down × Extrapolator (diff. ≥ 4)	-0.045** (0.017)	-0.165*** (0.060)	-0.306** (0.115)	-0.016 (0.010)	-0.019 (0.017)	-0.127 (0.084)	-0.178 (0.129)
DAX down × Neutral (-4 ≤ diff. < 4)	-0.019* (0.011)	-0.064* (0.037)	-0.179** (0.075)	-0.007 (0.008)	-0.004 (0.013)	-0.025 (0.059)	-0.154** (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
Investor FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Summary

Result 1:
There is strong heterogeneity in investors' perceived autocorrelation of returns, with a majority believing in mean reversion.

Result 2:
Beliefs about the autocorrelation of returns predict investors' trading decisions.

Manipulation checks

Did the treatment change respondents' beliefs about the autocorrelation of stock returns?

Agreement on 7-point scales to the statements (after the intervention):

- *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.*

Manipulation checks

Did the treatment change respondents' beliefs about the autocorrelation of stock returns?

	No sense to buy after high return		Positive return more likely after high return	
	(1)	(2)	(3)	(4)
Treatment	-0.054		-0.147***	
	(0.044)		(0.045)	
Treatment × Extrapolator (diff. ≥ 4) (a)		0.021		-0.375***
		(0.114)		(0.115)
Treatment × Neutral (-4 ≤ diff. < 4)		0.075		-0.084
		(0.080)		(0.081)
Treatment × Mean-reverter (diff. < -4) (b)		-0.155***		-0.114*
		(0.060)		(0.062)
Extrapolator (diff. ≥ 4)	-0.018	0.008	0.143**	0.288***
	(0.071)	(0.098)	(0.072)	(0.102)
Mean-reverter (diff. < -4)	0.046	0.160**	-0.127**	-0.113
	(0.051)	(0.070)	(0.053)	(0.072)
p-value (a=b)		0.174		0.047
Observations	1,961	1,961	1,961	1,961
R-squared	0.08	0.08	0.04	0.04

Notes: All outcome measures are z-scored using the mean and the standard deviation in the sample. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

# Updating of expectations in response to treatment

Do respondents in the treatment group **update future return expectations** towards the treatment information?

Updating of expectations in response to treatment

Our treatment implies an **information shock** that should be relevant for respondents' expectations about the **12-months ahead return** after the survey, which depends on:

- Respondent's perceived **return over the 12 months before the survey**.

- Respondent's prior beliefs about **autocorrelation** of stock returns.

Updating of expectations in response to treatment

Implied information shock to 12-month ahead return (p.p.) X Treatment

estimated coefficient: 0.115(0.044)***
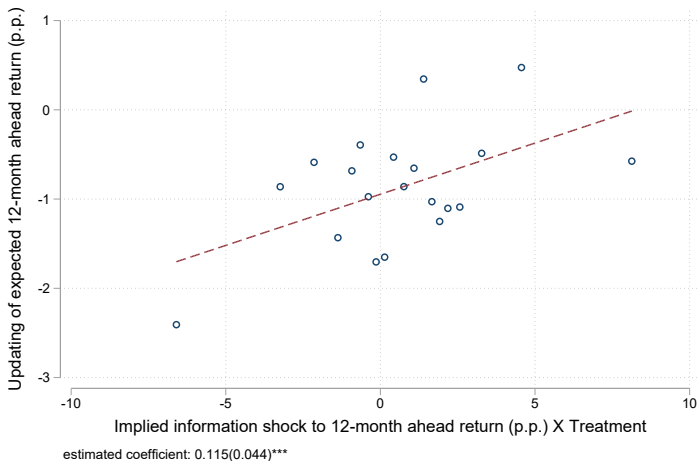
$$\Delta\exp_i = \alpha_0 + \alpha_1 \text{information shock}_i \times T_1 +$$
$$\alpha_2 \text{information shock}_i + \alpha_3 T_1 + \mathbf{\Pi}^T \mathbf{X}_i + \varepsilon_i$$

Updating of beliefs and persistence

- Changes in perceived autocorrelation and in expected returns **persist** in a four-week follow-up survey (at almost the same magnitude).

- **Experimenter demand effects** less likely to be driving our results (de Quidt et al., 2018).

- Results unlikely due to unconscious **numerical anchoring** (Cavallo et al., 2017; Haaland et al., 2021).

- Persistent change in investors' **subjective model** of the stock market in response to information provision.

Summary

Result 1:
There is strong heterogeneity in investors' perceived autocorrelation of returns, with a majority believing in mean reversion.

Result 2:
Beliefs about the autocorrelation of returns predict investors' trading decisions.

Result 3:
Respondents adjust their beliefs about the autocorrelation of returns and about 12-month ahead returns in response to the information.

Changes in trading behavior

Do changes in beliefs in response to our treatment affect future trading behavior?

- Transaction data until March 2020.
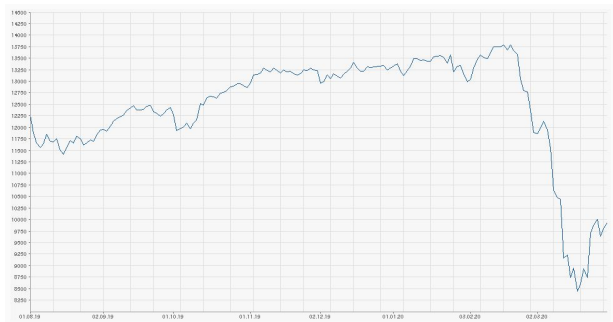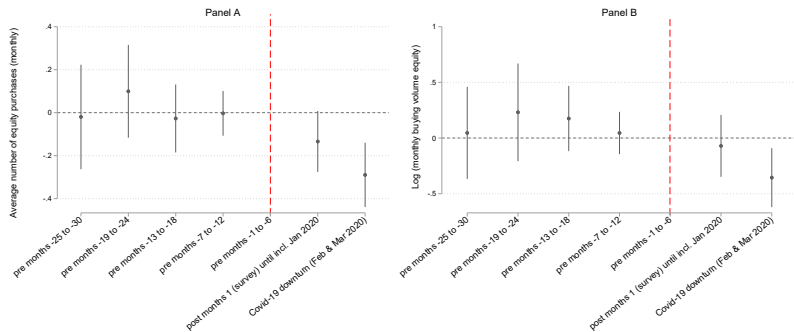- Very unique set up (stock market crash).

Figure: Development of the DAX from August 2019 to March 2020

Changes in trading behavior

Treatment effects on trading activity among prior mean reverters:

Notes: This figure displays coefficient estimates on the interaction terms of the treatment indicator with the different pre- and post-periods based on investor-month level estimations.

- Moderate effect on trading decisions in the **short term**.

Changes in trading behavior

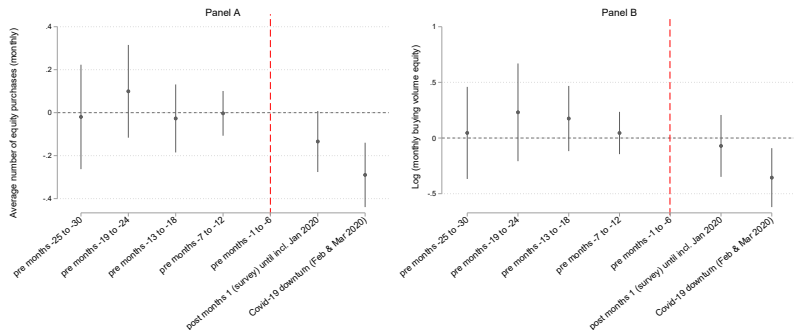Treatment effects on trading activity among prior mean reverters:

Notes: This figure displays coefficient estimates on the interaction terms of the treatment indicator with the different pre- and post-periods based on investor-month level estimations.

- Moderate effect on trading decisions in the **short term**.
- Treated mean reverters purchase **significantly less equity** during the COVID-19 crash.

Summary

Result 1:
There is strong heterogeneity in investors' perceived autocorrelation of returns, with a majority believing in mean reversion.

Result 2:
Beliefs about the auto-correlation of returns predict investors' trading decisions.

Result 3:
Respondents adjust their beliefs about the autocorrelation of returns and about 12-month ahead returns in response to the information.

Result 4:
Changes in beliefs about the autocorrelation of aggregate returns induced by the experimental intervention reduce equity purchases during the COVID-19 crash among those believing in mean reversion before the intervention.

Outline of talk

Implications and conclusion

- Part of the previously documented **disagreement** in stock return expectations across households (Giglio et al., 2021a) due to heterogeneity in subjective models.

- Findings support theories in which **trade** occurs because agents arrive at different expectations about the future even when they hold identical information about recent realizations (Harrison and Kreps, 1978; Scheinkman and Xiong, 2003).

- Importance of accounting for **heterogeneous subjective models of the world** in macroeconomics and finance.

- Even **experienced retail investors** make trading decisions based on **erroneous beliefs** about the aggregate predictability of the stock market.

- Beliefs about the stock market can be **persistently changed** through provision of factual information, which affects economic decisions months later.

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Outline of talk

4 Appendix

Prior Perceptions of 12-month Stock Market Returns

- Prior perceptions of stock market returns over past 12 months

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Betrachten wir die vergangenen 12 Monate:

Was glauben Sie, welche Rendite (in Prozent) hat der DAX über die vergangenen 12 Monate erzielt?

Mit Rendite ist die prozentuale Wertänderung einer Anlage in den Deutschen Aktienindex (DAX) über die vergangenen 12 Monate gemeint. Eine positive Zahl bedeutet, dass der Wert des DAX gestiegen ist, eine negative Zahl bedeutet, dass der Wert gefallen ist.

[_____] Prozent

Nach Ihrer Einschätzung würde ein Anleger, der vor 12 Monaten 100 EUR in den DAX investiert hat, heute EUR erhalten.

Note: Percentages are automatically translated into EUR terms below the entry field.

- Confidence

Wie sicher sind Sie sich mit Ihrer Antwort?

Überhaupt nicht sicher						Sehr sicher
1	2	3	4	5	6	7
○	○	○	○	○	○	○

▶ Back

Information treatment: Treatment text

Egal in welchen Bereich die Rendite über die vorangegangenen 12 Monate fiel, betrug die Rendite des DAX über die darauffolgenden 12 Monate im Durchschnitt immer zwischen 7,4 und 9,6%.

Das heißt, egal wie hoch die Rendite des DAX über ein bestimmtes Jahr ist, ist die beste Vorhersage über die Rendite im Folgejahr ungefähr die langfristige historische Durchschnittsrendite in Höhe von 8,5 Prozent.

Hohe oder niedrige Aktienmarktrenditen über ein bestimmtes Jahr lassen folglich keine Rückschlüsse über die Aktienmarktrenditen im Folgejahr zu.

Stellen Sie sich vor, man könnte vorhersagen, wann die Aktienkurse überdurchschnittlich stark steigen. Institutionelle Großinvestoren würden dann Wertpapiere in großen Summen kaufen. Dadurch würden die Aktienpreise einen Aufwärtsdruck erfahren. Die Möglichkeit, eine überdurchschnittlich hohe Rendite vorherzusagen, wäre sofort dahin.

Figure: Treatment text provided to participants in the treatment group in support of graphical treatment.

▸ Back

Information treatment: Control group

Denken Sie nun an die historische Entwicklung des DAX in den letzten 50 Jahren. Die durchschnittliche jährliche Rendite des DAX über diesen Zeitraum lag bei

8,5 Prozent pro Jahr

Figure: Information on avg. hist. annual return of the DAX provided to participants in the control group.

▸ Back